CIVIL ENGINEERING

DECEMBER 1950

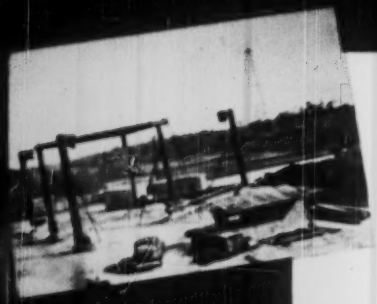
THE MAGAZINE OF ENGINEERED CONSTRUCTION

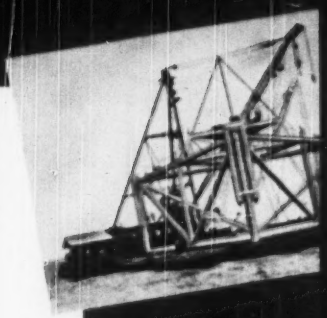
Slip Forms Reduce Cost of Tall Bridge Piers—Holt

Photogrammetry Locates Pennsylvania Turnpike Extensions—Williams

Miami Suffers Slight Structural Damage in Severe 1950 Hurricane—Anderson, Saffir

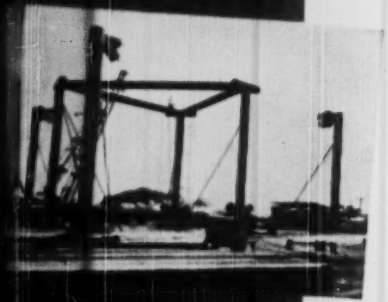
THE WORLD'S MOST UNUSUAL SOIL BORING JOB

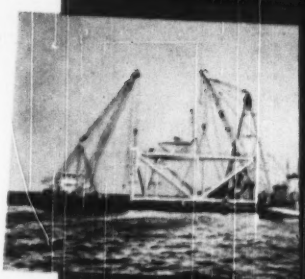




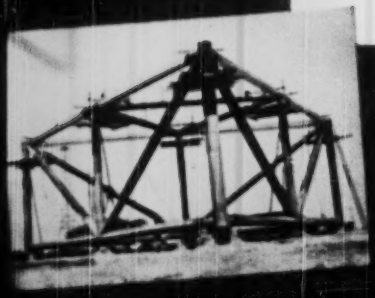
The Problem: 250-foot Gow soil borings, accurately spotted five to ten miles offshore in the deep waters of Lake Maracaibo, Venezuela. The Project: pile foundations for future oil-well derricks. Special Hazard: 70-mile-an-hour "chubascos," violent squalls that would wreck temporary platforms.

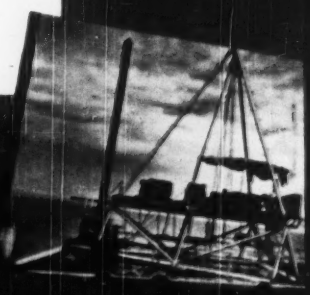
The Solution: Raymond engineers designed a triangular *floating* platform of 22" steel pipe, welded and watertight. The three corner members were left open for 120-foot-long anchor spuds. Assembled on shore from steelwork fabricated in New York, the 60-ton float was skidded onto two barges and towed 32 miles to the first boring location where floating derricks launched it. Spuds and deck equipment were placed later, including winch-controlled anchors at each corner to help in spotting the float and holding it steady during boring operations.





The Moral: When the problem is tough, the answer must still be *right*. That's when it pays to have a resourceful, experienced organization on the job . . . like Raymond!





Raymond

CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

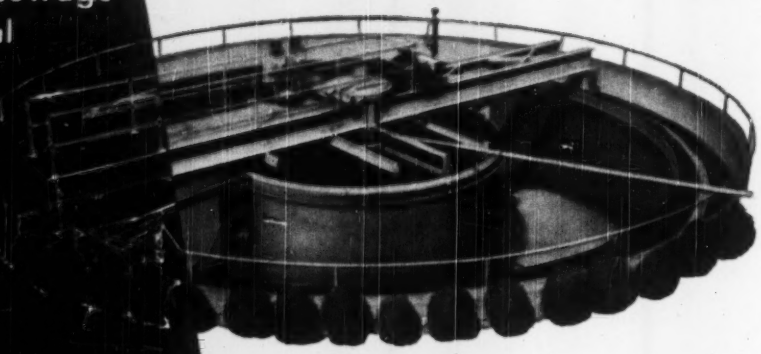
Painted for U. S. Pipe & Foundry Co. by Paul Laune

There's a solid satisfaction in specifying cast iron pipe. You know that your choice coincides with the judgment of leaders of your profession the world over. And when the line is backfilled, you are confident that it will serve throughout a long life at a low annual maintenance cost. This has been true of cast iron pipe for centuries; yet in the fifty-one years since our Company was founded, notable advances in manufacturing methods and controls have been made, resulting in a finer, more uniform pipe. United States Pipe and Foundry Company, General Offices: Burlington, N. J. Plants and Sales Offices Throughout U. S. A.

U.S. PIPE

CIVIL ENGINEERING, The Magazine of Engineered Construction, December, 1950. Vol. 20, No. 12. Published monthly by the American Society of Civil Engineers. Publication office: 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 25, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

new and better way
to preaerate sewage and industrial wastes . . .



the low cost DORRCO AERATOR-CLARIFIER

The new Dorrco Aerator-Clarifier is a compact, low-cost unit combining the functions of *preaeration, flocculation* and *sedimentation* in a single tank. It is applicable wherever it is advantageous to increase suspended solids and B.O.D. removals—where odor control or elimination is necessary—or where flocculation with or without chemicals, is beneficial. It fits equally well into primary or secondary treatment flowsheets . . . with notable advantages in both.

Highlights of Aerator-Clarifier superiority are listed at the right, but it will pay you to check the complete story of the design and operating characteristics. A Dorr engineer will gladly tell you more . . . without obligation.

DORRCO AERATOR-CLARIFIER ADVANTAGES as compared with separate preaeration and sedimentation tanks.

1. **Compact** . . . single tank saves ground space.
2. **No solids interference in aeration chamber** . . . grit and heavier solids settle quickly, avoiding interference with flocculant material.
3. **No breakup of floc structure** . . . low transfer velocities from Aerator to Clarifier section eliminates breakup of flocculated material.
4. **Minimum of short circuiting** . . . spiral-flow aeration effect in Aerator minimizes short circuiting.
5. **Simple maintenance** . . . aeration tubes are removable for cleaning or replacement without interfering with operation of the unit.
6. **Low cost** . . . single tank and simple design cut installed cost.

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.

NEW YORK • ATLANTA • TORONTO
CHICAGO • DENVER • LOS ANGELES

RESEARCH AND TESTING LABORATORIES
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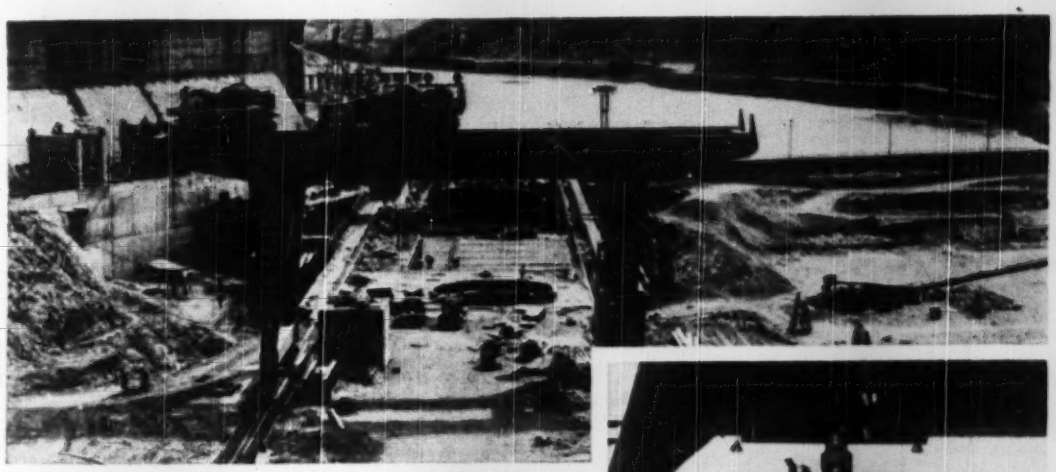
PETREE & DORR DIVISION, STAMFORD, CONN.

ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

RESEARCH ENGINEERING EQUIPMENT



325-ton G-E powered gantry Star Iron and Steel crane at the Davis Dam site on the Colorado River. The crane must operate almost continuously during installation of five turbine generators.

Jogging a 325-ton load 1/10,000 inch at a time

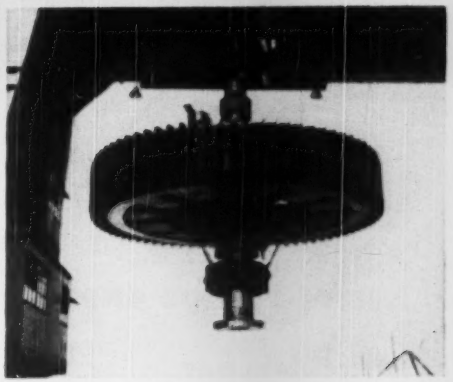
... Electrically

G-E powered DAVIS DAM CRANE positions heaviest loads accurately, smoothly, safely

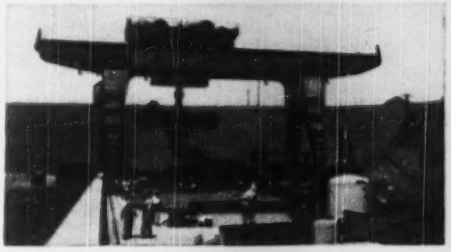
It's an unusually versatile crane drive that can either handle an empty hook at twice rated speed, or jog a 325-ton load to within 1/32 inch. Bureau of Reclamation's specifications for Davis Dam outdoor powerhouse crane called for just that type of operation.

The General Electric drive beat the requirements for this job by a wide margin—the full-load jogging accuracy in the lowering direction was .000114 inch.

Electrified construction equipment can work for you too—can give you the fast, safe, efficient service your job calls for. And when you combine G-E motors and control with a G-E power distribution system, you'll get all that electrified equipment can offer, with the extra benefits of G-E engineering assistance in application, installation and service. *Apparatus Dept, General Electric Company, Schenectady 5, N. Y.*



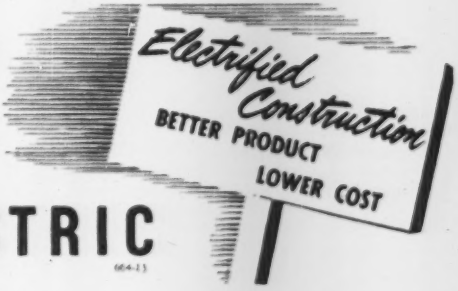
G-E hoist motors and control lift and accurately position turbine-generator rotors weighing over 300 tons.



From hoist and trolley motors atop the bridge to master switches inside the cab, all G-E equipment on this Star Iron and Steel crane works smoothly to move heavy loads accurately and safely.

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.



GENERAL ELECTRIC

66-113

Relieving platform, which supports New York's East River Drive, rests on 72,000 creosoted piles. Wood form, pictured here, carries reinforced concrete slab.

72,000

CREOSOTED PILES SUPPORT NEW YORK'S EAST RIVER DRIVE!

New York's East River Drive, completed in 1942, is one of the city's most impressive waterfront parkways. This Drive is about 7 miles long; in six lanes, it carries two-way high-speed traffic. For a distance of 4.3 miles, relieving platform bulkheads were built along the shore of the East River to support the highway. These relieving platforms rest on approximately 72,000 creosoted timber piles, driven offshore in water 20 to 30 feet deep.

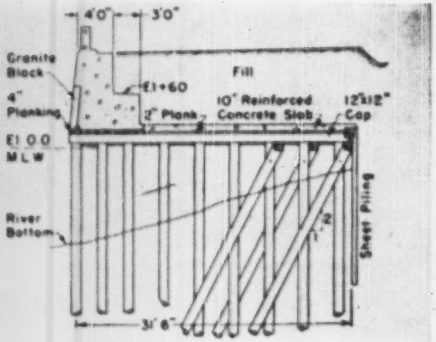
The engineers specified pressure-creosoted piles because of their economy and permanence. These piles are usually lower in cost than other permanent pile materials. The pressure-creosoting treatment protects them against marine borers; also, against decay and insect attack where cutoffs are above the water table.

When your projects require permanent construction *with economy*, Koppers Pressure-Creosoted Piles may be the best answer. Koppers Piles can be delivered on schedule, in lengths up to 150 feet. Write for quotations.

KOPPERS COMPANY, INC., PITTSBURGH 19, PA.

KOPPERS **PRESSURE-TREATED WOOD**

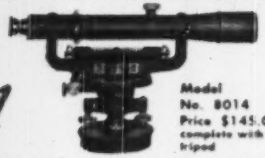
As reported in an article in Civil Engineering, April 1949, "Design is based on assumption that creosoted piles used will outlast other materials in structure."



Choose

the exact instrument you need from these three

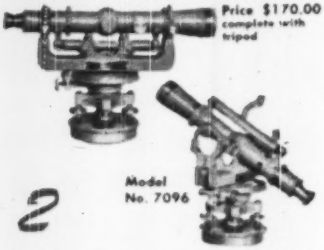
LOW PRICE MODELS



1

Model No. 8014
Price $145.00 complete with tripod

Finest 12" Dumpy Level available anywhere—gives you more features you want, more accuracy, more durability at less money than any other instrument. It has dust and dirt-free internal focusing and has coated optics for clearer distortion-free, sharper images.

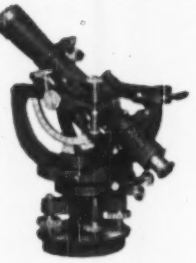


Price $170.00 complete with tripod

2

Model No. 7096

Here's the standard convertible level for the country for the past 30 years! No other instrument has the recognition and acceptance as given to the David White Carnegie Improved Convertible level. Now it's available to you with complete dust and dirt-free internal focusing and coated optics for clearer, sharper, distortion-free images.



Model No. 3000
Price $185.00 complete with tripod

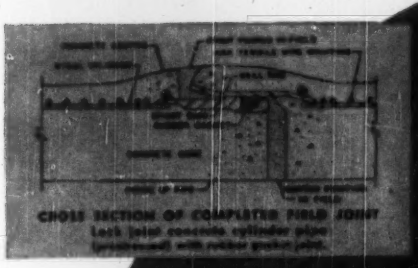
3

The David White "Universal" level-transit is the most practical and complete builder's instrument on the market. Now available in a *new improved model* — complete with internal focusing, coated optics — guarded vertical arc — in fact every possible feature to assure you lifetime durability and extreme accuracy.

CHOOSE the exact instrument you need from these three. Compare their outstanding features, their precise, yet rugged construction, their accuracy *and their price* with all others. Then you'll see why we say you'll buy "right" when you buy a David White. For complete information on any one or all three of these instruments, consult our nearest dealer — or write direct to David White Co., 359 West Court Street, Milwaukee 3, Wisconsin.

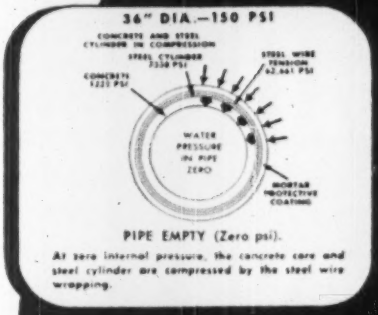
DAVID WHITE COMPANY

We offer complete, prompt repair service on all makes of instruments — levels, transits, theodolites, etc.



CROSS SECTION OF COMPLETED FIELD JOINT
Lock joint concrete cylinder pipe (prestressed) with rubber gasket joint.

# of Prestressed Concrete Cylinder Pipe is gaining increasingly wide acceptance in the West


36" DIA.—150 PSI
CONCRETE AND STEEL CYLINDER IN COMPRESSION
STEEL CYLINDER 7350 PSI
STEEL WIRE TENSION 62,661 PSI
CONCRETE 1225 PSI
WATER PRESSURE IN PIPE ZERO
MORTAR PROTECTIVE COATING

PIPE EMPTY (Zero psi).

At zero internal pressure, the concrete core and steel cylinder are compressed by the steel wire wrapping.

CONCRETE AND STEEL CYLINDER STILL IN COMPRESSION
STEEL CYLINDER 919 PSI
STEEL WIRE TENSION 69,360 PSI
CONCRETE 187 PSI
WATER PRESSURE 150 PSI

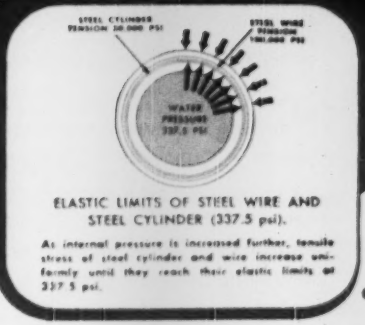
WORKING PRESSURE (150 psi).

At working pressure of 150 psi, the compression in both the steel cylinder and concrete core is partially relieved by the internal pressure of the water, but cylinder and lining still remain in compression.

Complete information upon request.

CONCRETE AND STEEL CYLINDER AT ZERO COMPRESSION (172 psi).

With internal pressure at 172 psi, the compressive stress in the concrete core and steel cylinder is zero. They go into tension only after pressure increases past this point.



ELASTIC LIMITS OF STEEL WIRE AND STEEL CYLINDER (337.5 psi).

At internal pressure is increased further, tensile stress of steel cylinder and wire increase uniformly until they reach their elastic limits at 337.5 psi.

This design of pipe is covered by A.W.W.A. Tentative Standard Specification (7B. 2-T) for Reinforced Concrete Water Pipe of the Steel Cylinder Type—Prestressed. Also covered by Extinguisher reports 1720 and 1721 of the Underwriters' Laboratories, Inc.

American PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines

P. O. Box 3428, Terminal Annex, Los Angeles 54, California

Main Offices and Plant—4635 Firestone Blvd., South Gate, Calif.

District Sales Offices and Plants—Oakland • San Diego • Portland, Ore.

2 giant new "Caterpillar" Earthmovers

. . . built to outspeed, outwork and outlast all comers!

With their high speeds and huge capacities, these two new "Caterpillar" Earthmovers have what it takes to push work through ahead of schedule. For national defense or private enterprise — on roads, dams, levees, airports or general construction — you can count on them for peak production.

Both these giants are powered by the new 225-HP., 6-cylinder "Cat" Diesel Engine. The 4-wheel DW20, with top speed of 26.6 m.p.h., is available with three matched units: the W20 Wagon, the No. 20 Scraper and the No. 20S 'Dozer. The 2-wheel DW21 has a top speed of 20 m.p.h. and trails the No. 21 Scraper. Features are described on the opposite page.

Here are typical reports on the DW20-W20 unit (25 cu. yds. heaped capacity): "You can run away from other rigs with it," says Operator Robert England. "The dump control is handy and easy to operate. It's got good brakes — you can stop it still, loaded. It's safe on turns and grades. It shifts easy and fast. The engine's got guts." Dragline Operator R. D. Johnson adds: "It's good and wide — you don't waste a bucket. It gets in and out faster than any I ever loaded."

THE DW20 TRACTOR AND W20 WAGON UNIT

This big-capacity unit offers:

17 cu. yds. capacity, struck; 25 cu. yds., heaped.

Travel speeds, through five gear ratios, from 2.88 to 26.6 m.p.h.

Wide-mouthed hopper to provide easy-to-hit target for shovel or dragline loading.

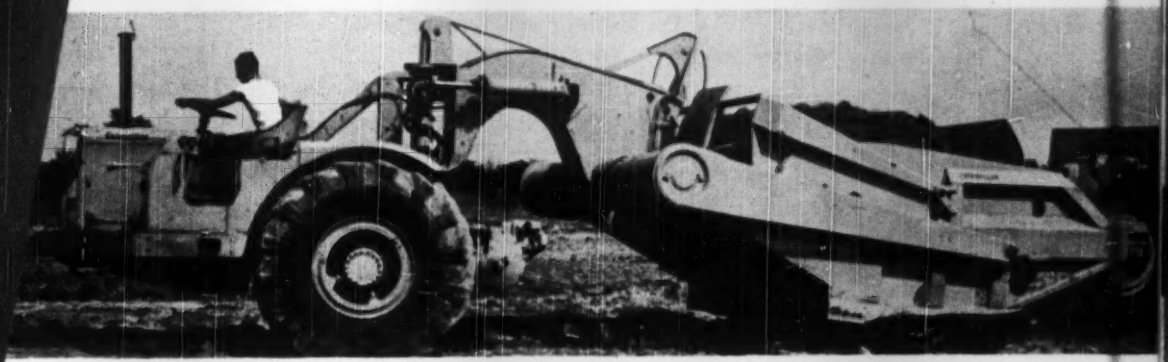
Controlled dumping — openings can be varied without mechanical adjustment — permitting either dumping or windrowing.

Accurate hydraulically controlled dumping with positive mechanical lock on dump doors.

The DW20 Tractor with No. 20 Scraper offers:

The same capacities, speeds and general specifications (except in type of gooseneck) as the No. 21 Scraper.

The DW20 Tractor is also available with the No. 205 Bulldozer.



THE DW21 TRACTOR AND NO. 21 SCRAPER UNIT

This big-capacity unit offers:

Full 90° turn each way—non-stop turn in 35 ft.

15 cu. yds. capacity, struck; 19½ cu. yds., heaped. With available 12" extensions: 18 cu. yds., struck; 22½ cu. yds., heaped.

Travel speeds, through five gear ratios, from 2.16 to 20 m.p.h.

Bowl and apron designed to promote "boiling" action of earth through center of load—for full-measure yardage, minimum loading time.

Large low-pressure tires for easy load flotation.

'Dozer-type ejection for positive "kicking out" of sticky material; dependable spring-action ejector return.

Open bowl design for visible loading under shovel or dragline.

Adjustable rear axle to permit level cuts and desired settings.

Double bottom of special alloy steel. Self-sharpening, reversible cutting edge.

High apron lift, low center of gravity.

Built to the exacting standards that characterize all "Caterpillar" equipment, these big yellow earthmovers are production boosters from the word "go!" What's more, your nearby "Caterpillar" dealer is on call for immediate service. For full information about these rigs, see him or write the factory.

•

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

DW20 AND DW21 TRACTOR FEATURES

NEW ENGINE: The completely new 6-cylinder "Cat" Diesel Engine . . . 225 HP. at 1900 r.p.m. available at the flywheel . . . 275 HP. peak capacity at 2000 r.p.m. tested in accordance with A.S.M.E. Power Test Codes.

TRANSMISSION: Constant-mesh transmission and heavy-duty clutch. Special locking device prevents gears from becoming disengaged.

STEERING: Hydraulic booster steering follows the natural "feel-of-the-road" hand guidance. Heavy steel stops keep gooseneck of drawn equipment from jack-knifing.

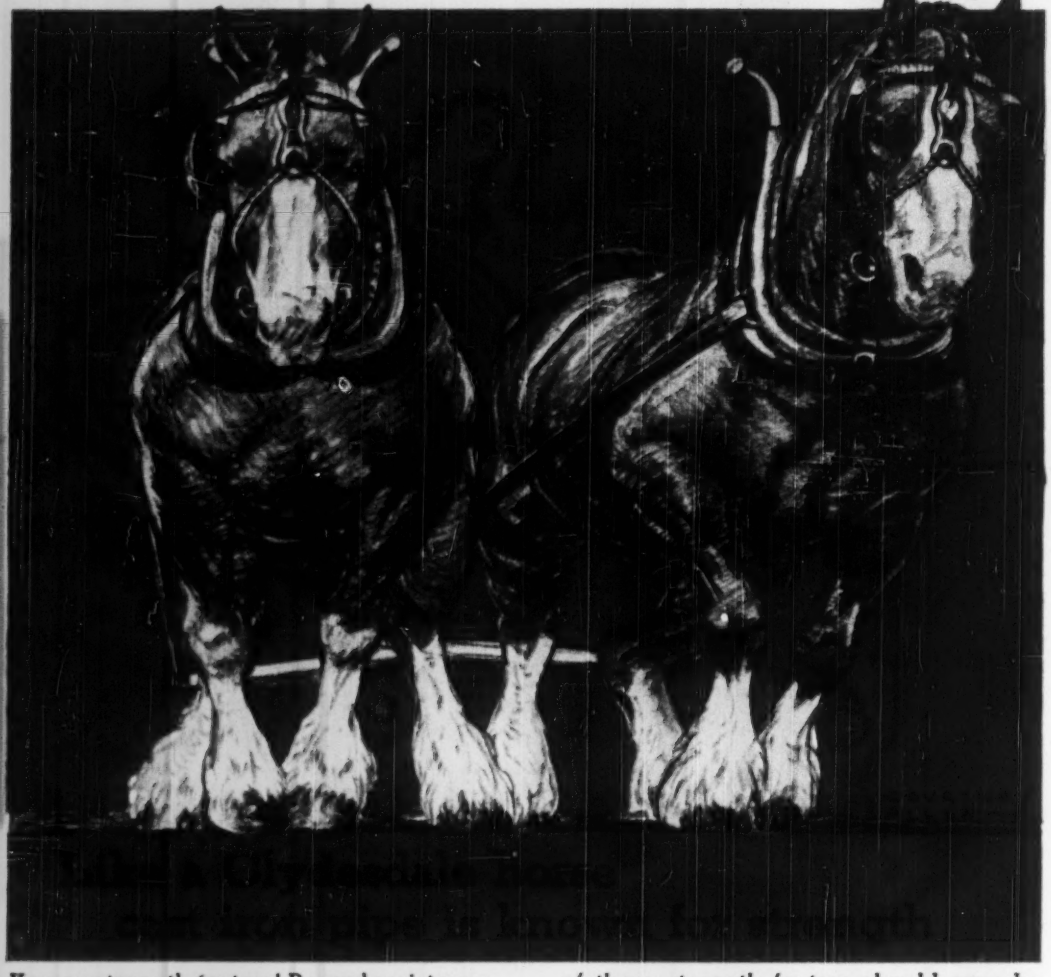
BRAKES: Each large, heavy-duty brake is 22" in diameter, 7" wide. Compressed air energized brakes on both tractor and drawn member of unit. Handy control valves for applying both sets of brakes, and to either right or left driving wheel.

OPERATOR COMFORT: Airfoam rubber cushion on bucket-type seat mounted on coil spring with hydraulic snubber. All controls within easy reach. Excellent visibility.

CATERPILLAR
REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS
MOTOR GRADERS • EARTHMOVING EQUIPMENT

in city streets lay pipe



Known strength factors! Proved resistance to corrosion! These are your only safe and sure guides to long life and low maintenance expense of water, gas and sewer mains laid under costly modern pavements. The four strength factors that pipe must have to survive traffic shocks, heavy external loads, beam stresses and severe working pressures are listed on the page opposite. *No pipe that is deficient in any of these strength factors should ever be laid in paved streets of cities, towns and villages.* Cast iron water and gas mains, laid over a century ago, are serving in the streets of 30 or more cities in North America. These attested service records prove that cast iron pipe not only assures you of effective resistance to corrosion but all the strength factors of long life and economy, as well.

known for STRENGTH

No pipe that is deficient in any of the following strength factors should ever be laid under paved streets.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

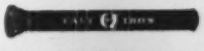
When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

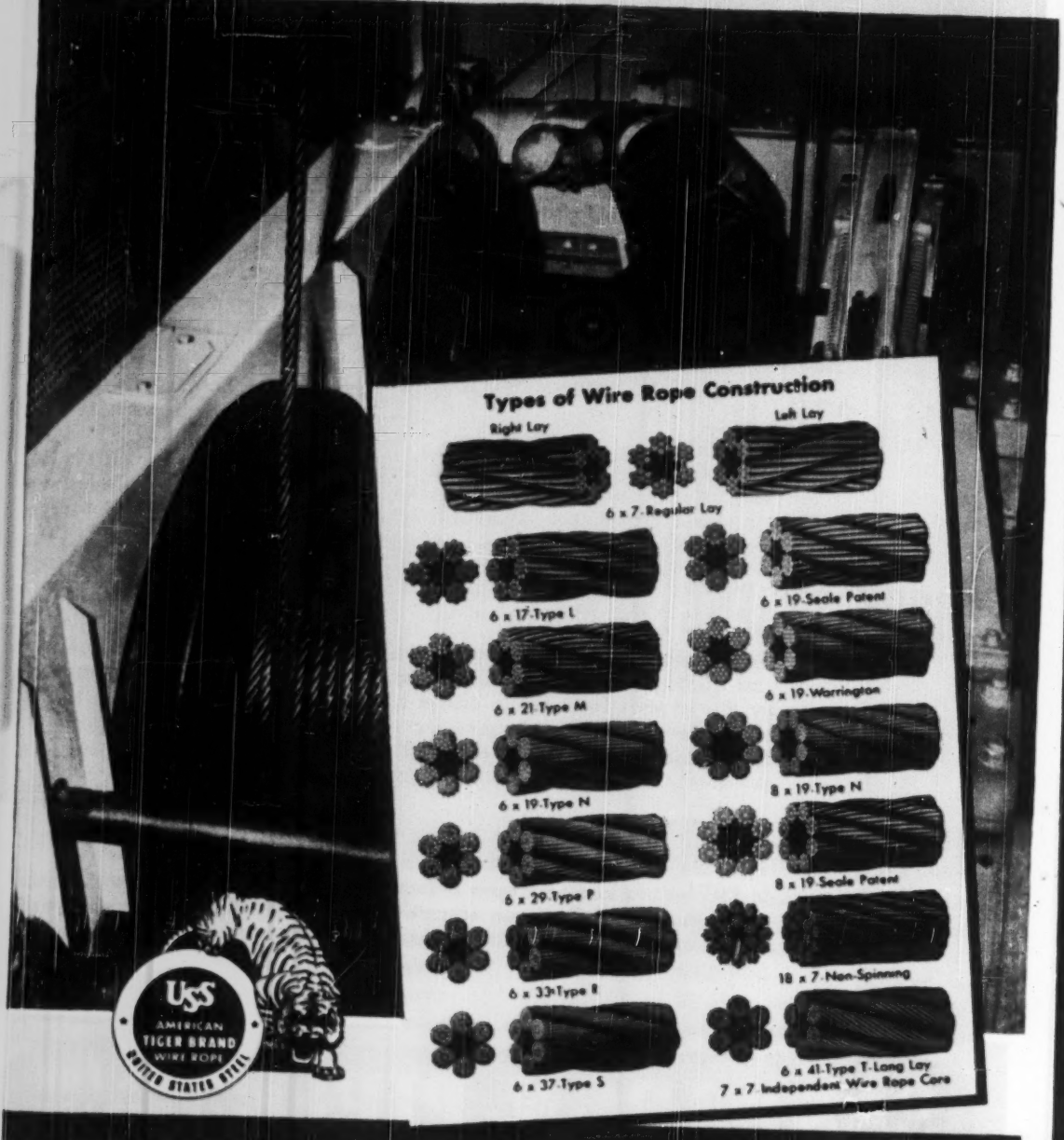
In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.



CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

CAST IRON PIPE SERVES FOR CENTURIES

The Tiger Brand Specialist says—



"Here's what you should know about wire rope —and how to select, use and care for it."

THE three most important qualities that wire rope must possess are (1) strength, (2) fatigue resistance, and (3) abrasion resistance. Whether the rope is used on hoists, cranes, excavators, conveyors, loaders or unloaders, these properties are required in varying degrees depending on serivce requirements.

STRENGTH—This is determined by size, grade, and construction. Wire for wire rope can be made in any desired tensile strength ranging from iron grade at approximately 100,000 lbs. per sq. in. to improved plow steel grade at approximately 250,000 lbs. per sq. in. The knack of making Tiger Brand Ropes with uniform strength throughout shows the skill of the wire rope manufacturer.

FATIGUE RESISTANCE—The ability to make wire that will stand thousands of bends over drums and sheaves without breaking is no small accomplishment. The wire must be made with just the right amount of toughness and ductility. Tiger Brand Wire Rope is made from wire especially fabricated for wire rope use. Ropes composed of a large number of small wires will have higher fatigue resistance than those made with a smaller number of large wires.

ABRASION RESISTANCE—This is determined by the size and chemistry of the wires, especially the outer wires as they are exposed to the most wear. Obviously, the larger the wire size the greater the resistance to abrasion. Furthermore, the high strength steels are better able to withstand wear because of a greater carbon content. This means that improved plow steel ropes would have the highest abrasion resistance.

Getting the right balance

Individually, the properties of strength, fatigue resistance, and abrasion resistance are not difficult to obtain . . . but in wire rope making, it is impossible to accent one property without detriment to the other two. That's why the skill and experience of the men who make Tiger Brand Wire Rope are so important. Satisfactory performance demands that running ropes possess all three properties and therefore it is necessary to obtain an effective balance which meets the requirements of your particular job.

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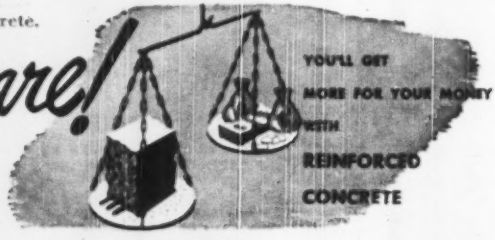

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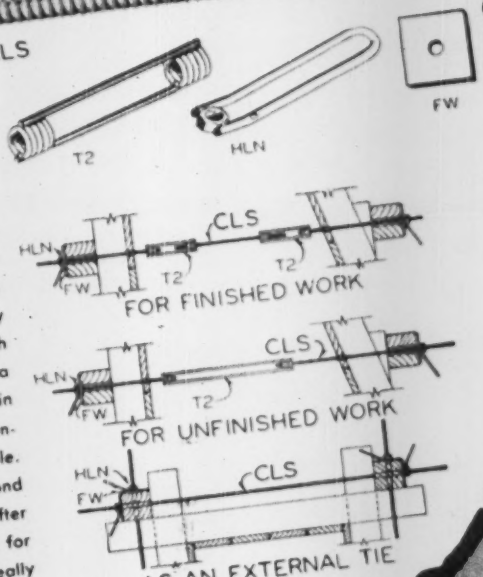

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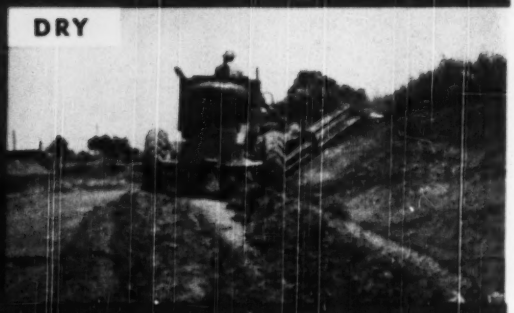

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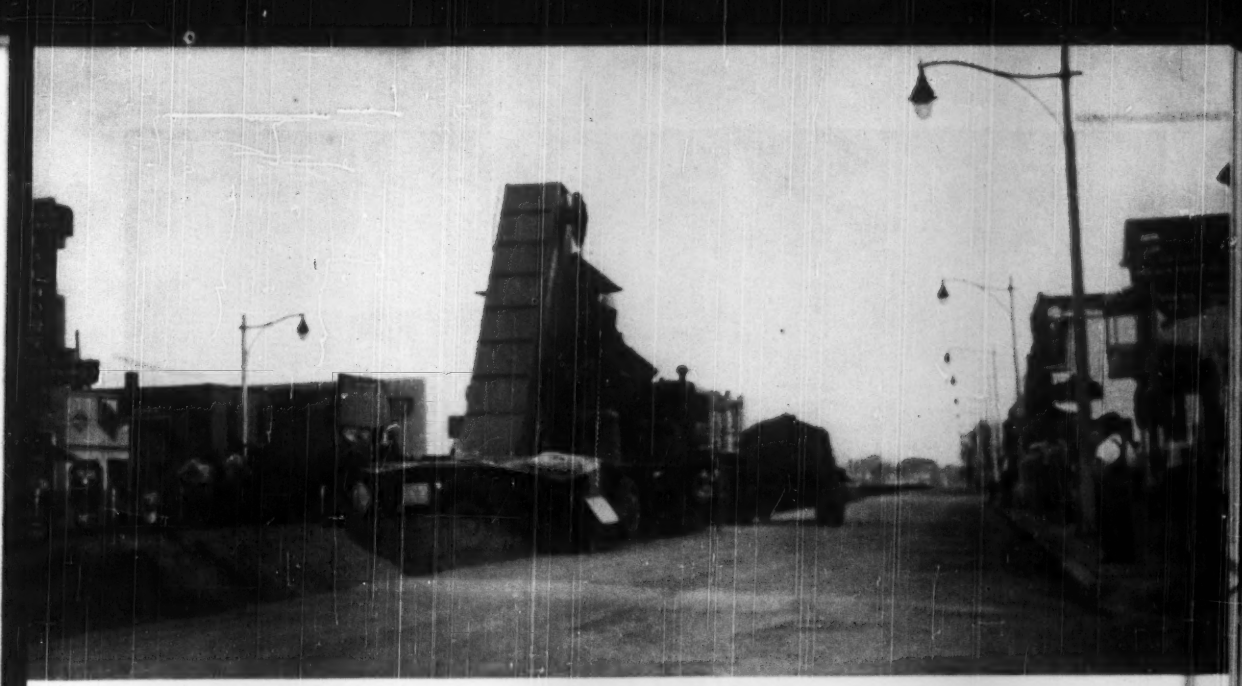

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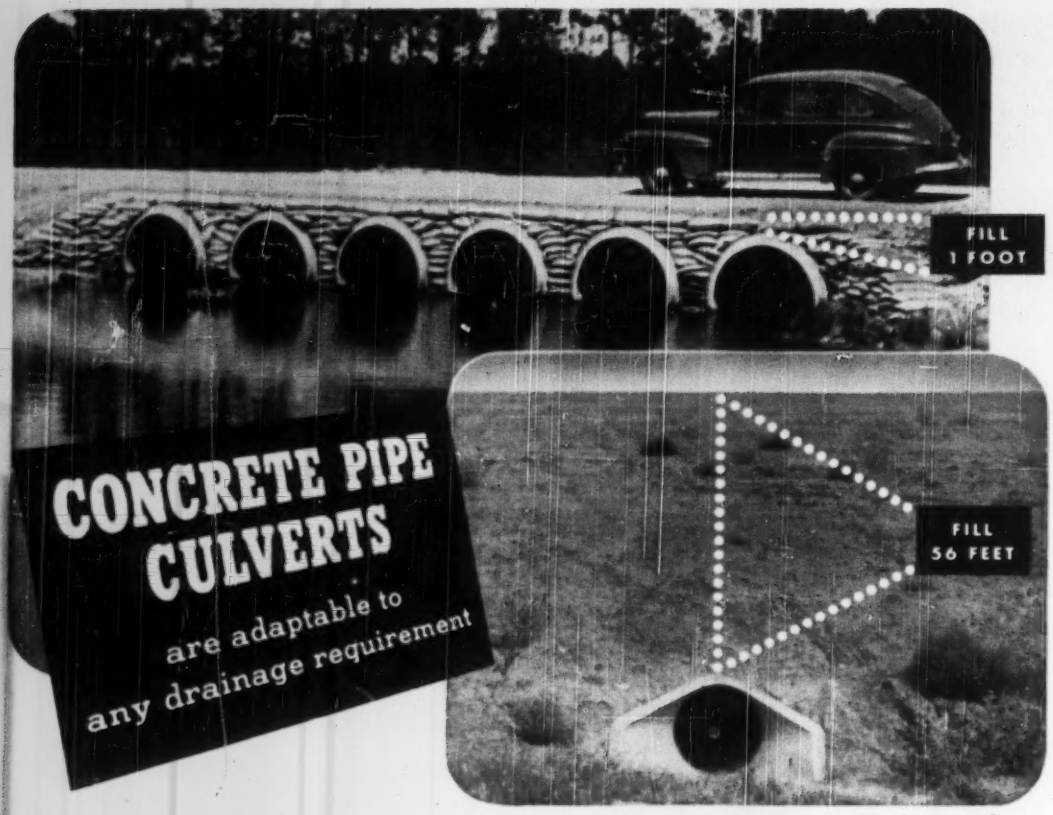

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WHETHER a culvert will have practically no overburden as in the multiple-line highway installation illustrated above or will have to bear an extremely high fill, it pays to select concrete pipe for the job. Adaptability to deep or shallow fills is only one of the qualities that makes concrete pipe the ideal choice for culverts anywhere.

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Upper photo shows multiple-line concrete pipe culvert in Jackson County, Miss. built by Mississippi State Highway Department. Lower photo shows 72-in. reinforced concrete pipe under 56-ft. fill on U.S. Highway 10 near Mandan, N.D. The culvert is 252 ft. long. Built by the State of North Dakota.

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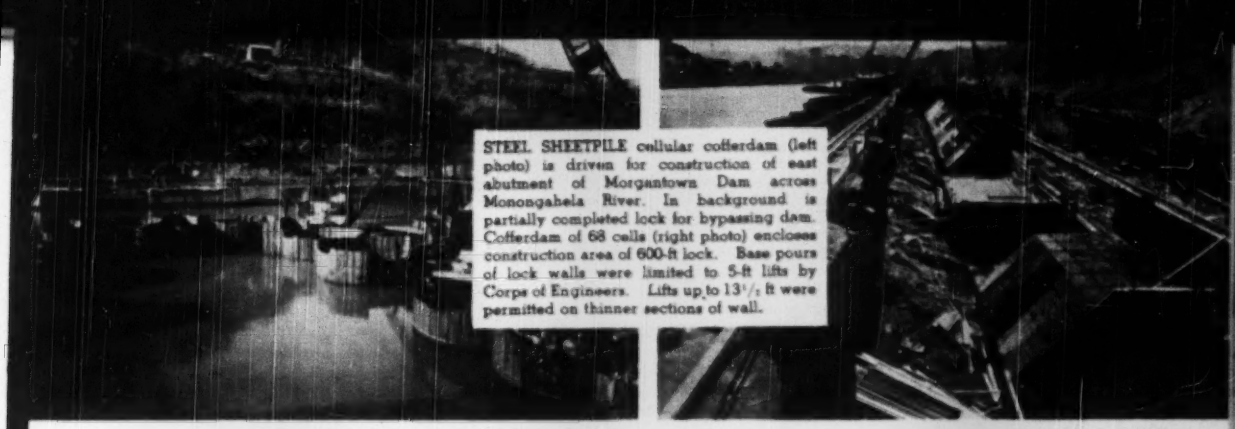
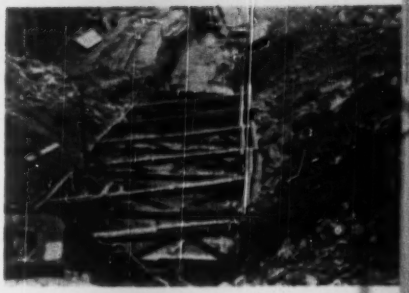


STEEL SHEETPILE cellular cofferdam (left photo) is driven for construction of east abutment of Morgantown Dam across Monongahela River. In background is partially completed lock for bypassing dam. Cofferdam of 68 cells (right photo) encloses construction area of 600-ft lock. Base pours of lock walls were limited to 5-ft lifts by Corps of Engineers. Lifts up to 13½ ft were permitted on thinner sections of wall.

New Lock and Dam Provide for Expanding River Traffic

R. B. JACKSON

Field Engineer, The Contracting Division, Dravo Corporation, Pittsburgh, Pa.



MONONGAHELA LIVED UP TO its Indian name, "river of sliding banks," necessitating special bracing at toe of slopes. Railroad tracks along shore also had to be moved back extra 20 ft to solid rock because of unstable soil along banks.

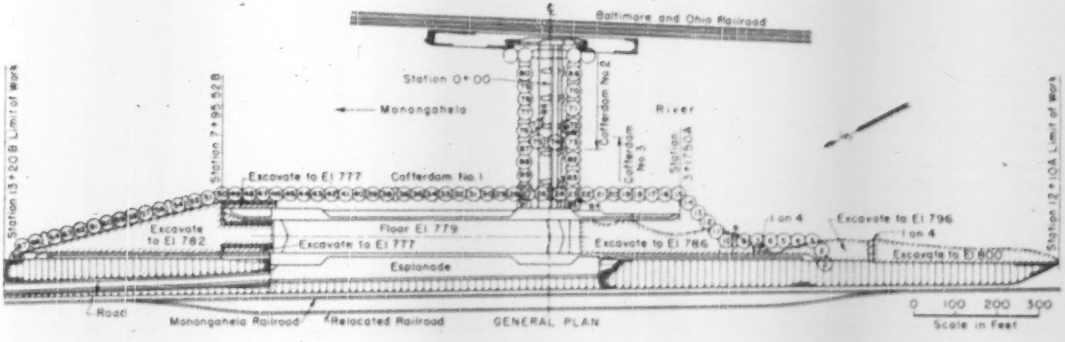
THE LOCK and dam now under construction by the Contracting Division of Dravo Corporation at Morgantown, W.Va., part of the U.S. Army Corps of Engineers navigational improvement plan for the Monongahela River, will replace two locks which are outmoded and too small for present or future river needs. The present river channel is 9 ft deep from Pittsburgh to the vicinity of Morgantown and 7 ft deep above Morgantown. Future plans call for a 12-ft channel to accommodate the large fleets of barges transporting coal downriver and steel and other products upriver. The new lock and dam at Morgantown are designed as part of this 12-ft channel system.

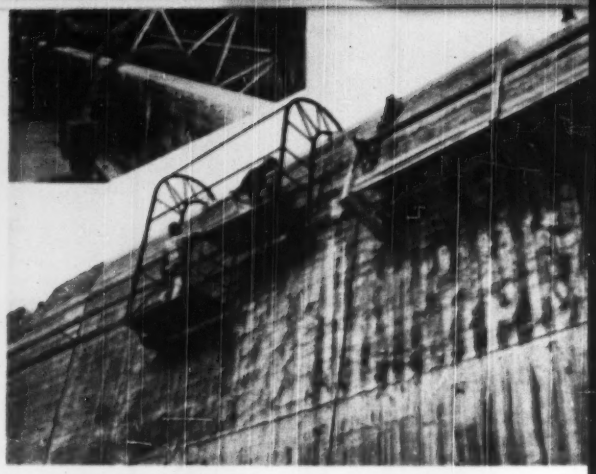
The Morgantown project includes a dam 67 ft high with six 60-ft-wide tainter gates allowing variable control of river flow. Total lift through the lock is 18 ft. Spillway piers are 10 ft wide and rise 46 ft above the crest of the dam. The lock chamber, on the west bank of the river, is 84 ft wide by 600 ft long, with guide walls extending about 600 ft each way, making the total length of lock and guide walls 1,897.5 ft.

To provide the necessary spillway capacity for the dam, the lock had to be located near the shoreline. This location necessitated excavation of approximately 206,000 cu yd of earth along the shore. This excavation increased the possibility of dangerous slides, a situation complicated by the proximity of the Monongahela Railroad tracks along the left bank.

The project was planned in three major construction stages. Stage 1 included the 206,000-cu yd excavation for the lock; construction of a cofferdam of 68 connected cells, each approximately 35 ft in diameter; removal of 40,000 cu yd of rock; and placing of 73,674 cu yd of concrete in the lock walls. Stage 2 included construction of a cofferdam of 26 connected cells 35 ft in diameter enclosing the east half of the dam;

FIG. 1. CONSTRUCTION of Morgantown Lock and Dam was divided into three stages. Stage 1 included driving of 68-cell cofferdam for construction of lock; Stage 2 included cofferdam for east abutment and east half of dam; and Stage 3, cofferdam for remainder of dam.





LOCK GATE LEAVES weighing 93 tons are positioned by two floating derricks. Cofferdams were then built at ends of lock chamber, and chamber was pumped out so that final adjustments could be made to gate assemblies.

building an open cofferdam with steel and timber bracing sets for enclosing the dam abutment area on the right bank; removing 3,500 cu yd of rock; placing 10,100 cu yd of dam concrete; and installing tainter gates, operating machinery and an operating bridge for the three spillway sections of the dam. Stage 3 consists of constructing a cofferdam of 19 cells enclosing the remainder of the dam; removing 1,500 cu yd of rock; placing 7,500 cu yd of concrete; and installing the remaining tainter gates, operating machinery and works to complete the project.

With the removal of a large part of the common excavation for the lock chamber by derrick boats, on September 9, 1948, Stage 1 began. The Monongahela Railroad tracks were moved back 17 ft to provide room for a slope of 1½ on 1 behind the land wall of the lock. An unusually warm winter caused considerable moisture in the ground and the Monongahela River began to live up to its Indian name, "the river of sliding banks." As a result, the railroad tracks had to be moved back an additional 20 ft to a solid shelf of rock. Flumes were installed to carry hillside drainage down the slope of the excavation, and timber bracing was erected at certain places along the toe of the slope to hold back the earth during concrete pours. In all, some 35,000 cu yd of additional excavation was made necessary by the slides. Excavation was done by derrick boats loading into side-dump hopper scows. The 68-cell cofferdam was completed in three months.

Rock excavation was started in February 1949 and shot and mucked successively from the upstream to the downstream end of the cofferdam. The construction plant consisted of six Dravo whirlers and a dinky track system for handling concrete. A new floating plant for concrete mixing, moored at the upstream end of the cofferdam, was supplied with cement and aggregate by barge. This plant has two 2-cu yd tilting mixers and automatic synchronized controls for weighing and batching all ingredients.

The first concrete for the lock chamber wall was poured April 1, 1949. The specifications called for 5-ft lifts in base pours, but permitted higher pours in the thinner wall sections. Five days were required between vertical lifts. Monoliths averaged 40 ft in length. A total of 536 pours was necessary to place the lock. The final miter sill pour was made on October 8 and the cofferdam was flooded on November 19. Stage 2 construction began on September 13, 1949, with the right-bank abutment cofferdam. This phase is completed and work is now progressing ahead of schedule on the rest of the project.

Corrosion Resistant Steel Used

Filling and emptying of the lock chamber will be controlled by four hydraulically operated 10 × 12-ft butterfly valves, two in the land wall and two in the river wall. Miter gates also are hydraulically operated. Considerable use was made of corrosion-resistant seal surfaces to help reduce gate maintenance problems.

One of the interesting aspects of the lock chamber construction was the use of a specially designed traveling scaffold for cleaning and painting the metal armor bands in the wall. This scaffold moved laterally along the length of the wall on rubber-tired wheels and provided safer and easier working conditions. It had two fixed platforms for working at two different levels.

SPECIALLY DESIGNED scaffolding for cleaning and painting armor bands moves laterally along wall. Insert above shows method of suspension of two-level scaffold.

Gates Transported by Barge

The heavy gates for the lock, as well as the tainter gates for the dam, were prefabricated at the Dravo Corporation shipyard and were transported by barge 110 miles on the Ohio and Monongahela Rivers to the project site. Two derrick boats, positioned side by side, lifted the 93-ton lock gate leaves from the barges and then the boats were towed into the lock chamber to set the gates on their pintles. Next, cofferdams were built at the ends of the lock, the chamber was pumped out, and final adjustments were made to the gate assemblies.

E. P. Daugherty is project engineer for the Corps of Engineers and D. P. Childress is superintendent for Dravo Corporation.

LOCK was completed six months after initial pour. Completed lock required 536 pours. View of landward guide wall after lock was flooded shows protective metal bands and notches containing anchor posts. Remains of first-stage cofferdam are seen at left.

Photogrammetry Locates 208 Miles of Pennsylvania Turnpike Extensions

FRANK J. WILLIAMS, Assoc. M. ASCE
Gannett Fleming Corddry & Carpenter, Inc., Harrisburg, Pa.

ONE OF the most extensive applications of aerial mapping to date is believed to be the location of the Pennsylvania Turnpike Extensions, a project having a total construction cost value in excess of $125,000,000. The Turnpike extensions run eastward from Carlisle to Philadelphia, and westward from a point 20 miles east of Pittsburgh to the Ohio line, a total length of about 208 miles. All preliminary line and grade studies, interchange layouts, grade separation studies, quantity estimates and cost estimates were based on topographic maps produced by photogrammetric methods.

Why Aerial Method Was Chosen

In June of 1947, when the Pennsylvania Turnpike Commission directed the writer's firm to proceed with location studies for the Extensions, many factors were present to direct our attention to aerial mapping. Field engineering manpower was in short supply, and the office personnel necessary to translate a conventional survey to paper was not available. It is not claimed that conventional methods were impossible, but it is certain that such methods could not have produced equal results in an equal length of time. For the Eastern Extension of the Turnpike the mappers delivered, in 145 calendar days, a complete topographic map 140 miles long and one mile wide. For the Western Extension, a similar map, 68 miles long and one mile wide, was delivered in 70 calendar days. These short time allotments were dictated by the requirements of the Turnpike Commission and resulted in a rate approximating one square mile of completed topographic map per day.

Aerial photographs, taken from an altitude of more than a mile, were exposed at intervals of about half a mile, to produce a forward overlap of 55 percent. Field survey parties established control points for the area photographed, the plates were rectified for tilt, and then the contouring began with very precise stereo-plotting equipment. This equipment operates on a principle similar to that of a military range finder. With it the operator measures the ground elevations exactly from the stereoscopic pairs of photographs, and is able to draw contours on the photographs with an accuracy of one-half the contour interval.

The finished map consisted of an inked linen topographic drawing, complete in cultural detail, to a scale of 1 in. = 200 ft, showing contours at 5-ft intervals. Other details provided for identification of dwellings by symbol, spot elevations at road and railroad intersections, summits, depressions, and saddles and a coordinate system to show grids at 1,000-ft intervals. Buildings with any side equal to 60 ft or more had to be shown in correct outline, but others were indicated by a symbol—a 25 × 25-ft square. Other symbols, for streams, swamps, and quarries, conformed closely to standard practice.

The maps as delivered were checked by our field parties independent of the aerial mapper. The specifications for map accuracy and the proper procedures to be used for checking on compliance with the specifications are two features that are subject to improvement. For example, the specifications provided that 90 percent of all elevations should be correct within one-half contour interval (or $2^1/_2$ ft) and that the remaining 10 percent should be in error by not more than one contour interval. The question that arises is how many "elevations" are there in a square mile?

For horizontal accuracy, the specifications required that 90 percent of all points be within $^1/_{50}$ in. (map scale) of their true coordinate position. Here the question arises as to how many "points" there are in a square mile or any other unit of area. Although these questions in themselves appear absurd, they show the need of developing a standard method of checking that will be fast, practical, and economical.

The procedure followed consisted of staking a 3,000-ft tangent line in the field and obtaining an accurate profile of it. This profile was then compared with the one plotted from the contour map for the same line. As each individual map sheet covered 3 sq miles, it can easily be seen that a more thorough check would have required a lengthy process. To check for horizontal accuracy according to the specifications would have meant referring each check point back to the coordinate system, a procedure calling for lengthy traverse surveys.

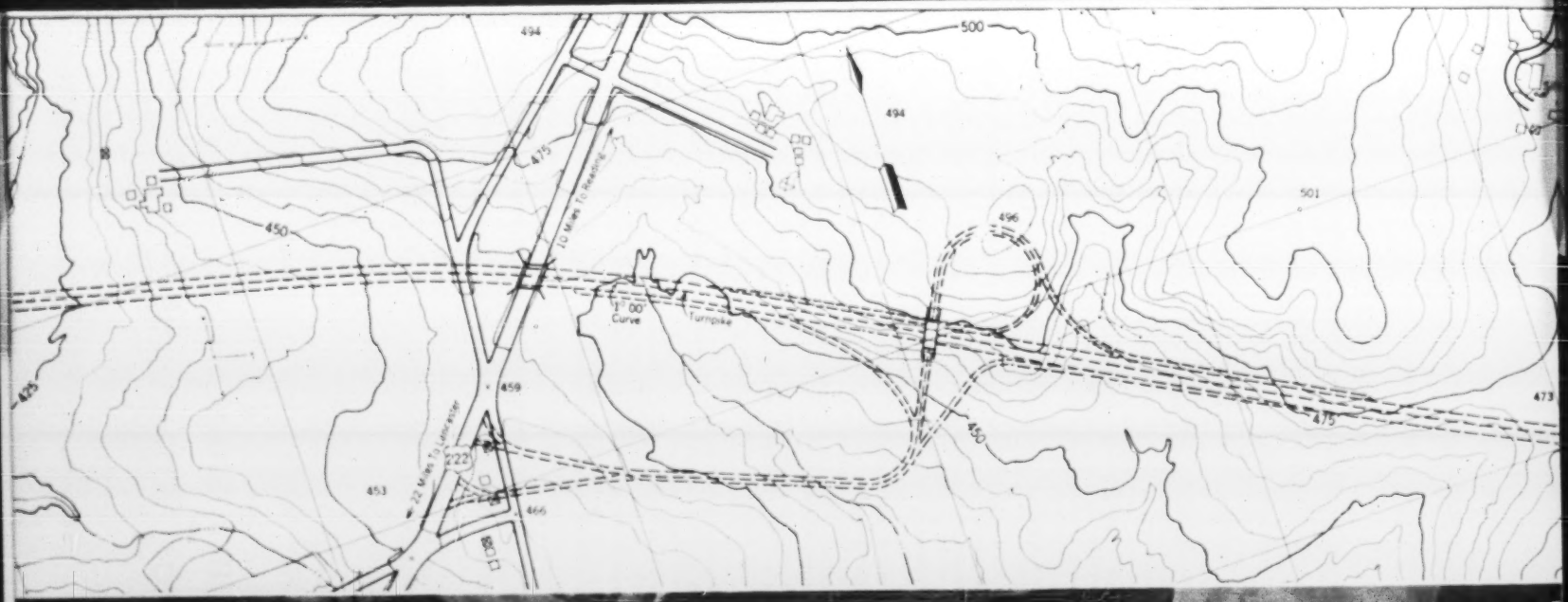
The checking methods used involved simple chaining between several well defined cultural features and comparing the distances with the corresponding scaled map distances. This procedure did not represent an attempt to slight the work or to blindly accept the maps without check, but it was apparent after the first attempt to apply the specified check that its cost would quickly equal the cost of the maps. An important factor to keep in mind was that the maps were intended for highway location studies and not for the development of contract drawings.

Location by Standard Procedure

Before the actual location studies were started, the Turnpike Commission established the fundamental design criteria, the most important of which set the maximum grade at 2 percent and the maximum curvature at 3 deg 30 min. The location study method itself did not differ from that used for maps obtained by conventional ground methods. Proposed lines were drawn on the maps, profiles taken from contours, and earthwork quantities determined from charts prepared for the purpose. As all intersecting roads were separated, similar methods were applied to the crossroads.

Interchange sites were also selected and laid out from aerial maps. Since the maps provided a mile-wide strip, it was possible to select a line with a minimum of road and stream crossings where economics indicated that such a line was advisable. Also, the openings of smaller drainage structures were more accurately determined because a well defined drainage area, easily determined by planimeter, was available, and it was not necessary to rely on field inspection, involving a good bit of guesswork.

Selection of a photogrammetric organization to do the work was handled on a competitive-bid basis in the conventional manner. Bids were re-


494
500
494
475
10 Miles To Reading
450
501
496
1° 00'
Curve
Turnpike
459
473
475
450
222
22 Miles To Lancaster
453
466

PHOTOGRAMMETRIC METHOD of locating Eastern Extension of Pennsylvania Turnpike is illustrated by section including intersection with U.S. Route 222. Method involves four main steps: (1) Aerial photographic pairs are taken with Brock glass-plate camera (see section of a single photo on facing page). (2) Contour map (also facing page) is prepared from aerial photographs by very precise stereo-plotting equipment. After map has been checked in field for basic accuracy, preliminary location is sketched on it (see dashed lines). (3) With this information, field parties make final location and secure measurements for preparation of construction drawings (not shown). (4) Actual construction is carried out (see oblique aerial photograph of interchange nearing completion above). Toll booths, landscaping, and final clean-up remain to be done. Approach legs in upper center are considerably spread out to provide for future separation with existing State Highway. Right-of-way for this second interchange has already been acquired, as indicated by angular fence above existing route. Western Extension was similarly located.

ceived from aerial mapping companies based on specifications containing time requirements, liquidated damage clauses, and so forth. Only a few organizations submitted bids for the entire work, and some submitted bids in combination with others. The most common combination consisted of an aerial photography group and a mapping organization with no flying facilities. However, the low bid came from a company (Aero Service Corp. of Philadelphia) that handled all the work from flying to the final inked tracings. The completed map for the Eastern Extension covered an area one mile wide and 140 miles long, for a total price of $82,000. This amounts to a few cents under $1.00 per acre, which certainly supports the claim that the method is economical.

For the Western Extension, the finished map was 68 miles in length, and also prepared by the Aero Service Corp. The cost was a total of $56,102, or about $1.29 per acre. The increase in cost over the map for the Eastern Extension was due primarily to the considerably rougher topography.

Successful Use of Method Elsewhere

Since completion of the Pennsylvania Turnpike design, the writer has had equal success with the photogrammetric method on similar projects. At present, a 23-mile section of U. S. Route 22 in Pennsylvania is being located by similar procedures. The aerial mapping in this case cost about $1.33 per acre. The highway covers a suburban area closely skirting the limits of three cities, thus increasing the drafting work and requiring more precise delineation. Another application, the New Jersey Turnpike, was limited to the use of photo enlargements only. These photos approximated a scale of 200 ft = 1 in. and were used to locate an 18-mile section near Camden. Fortunately, New Jersey has a well monumented coordinate system, so that it was not difficult to locate the various monuments on the photos by chaining from nearby well defined features.

It is not intended to imply that photogrammetry will solve all mapping problems with equal success, but its utility, speed and economy when properly applied cannot be denied.

No application should be attempted without some knowledge of the limits of accuracy of the method. It is not believed that it is quite ready for use in the preparation of construction drawings, or for obtaining contract quantities such as earthwork, although attempts have been made at such uses experimentally. The highway specifications of most states provide that all pay quantities shall be based on U. S. Standard Measure, which would preclude photogrammetric procedures. There is also a certain reluctance on the part of contractors to accept any measurement that does not involve the use of a steel tape.

In spite of these limitations, there can be no doubt that when speed is an important factor, and when the necessary limits of accuracy are well known in advance for the end result desired, photogrammetry can provide the answer to most if not all problems relating to the location of major highway improvements.

Hungry Horse Dam—Largest Single Contract of U.S.B.R. Now in Force

CONTRACT for Hungry Horse Dam was awarded in the spring of 1948 jointly to twelve large construction firms known as General-Shea-Morrison, for $43,000,000, the largest single construction contract of the Bureau of Reclamation now in force. Into the construction of this dam are going many years of engineering research, model testing, operating experience and construction know-how. For example it was found that the substitution of fly ash for 30 percent of the cement would make equally good or better concrete while at the same time effecting a saving of nearly $5,000,000.

The spillway, of the glory-hole type, will safely discharge floods of 50,000 cfs into the river below the toe of the dam. Spillway tunnel and abutment excavation was expedited by a new long-hole diamond-drill technique. Altogether, dam and spillway construction has involved the excavation of a million cu yd of rock and about 75,000 cu yd of common excavation. Concrete placement is at the rate of a million cu yd a year, or an average of about 4,800 cu yd a day during the seven-month placing season. One-third of the total contract yardage of 3,100,000 cu yd is now in place, and completion is scheduled for November 1953.

DESIGN—Variable-Thickness Arch Fits V-Shaped Canyon

L. G. PULS, Assoc. M. ASCE

Engineer, U. S. Bureau of Reclamation, Denver, Colo.

HUNGRY HORSE DAM is being constructed as an integral unit in the comprehensive program for development of the Columbia River and its tributaries for power, flood control and irrigation to serve agricultural and industrial areas in the Pacific Northwest. The reservoir is to be operated in conjunction with the extensive developments at Grand Coulee, Chief Joseph, McNary, and Bonneville Dams, and other proposed developments within the Columbia River Basin (Fig. 1). The Hungry Horse power plant is located at the toe of the dam in the original channel. The first power unit is scheduled to go on the line in October 1952.

The South Fork of the Flathead River, a tributary of the Columbia, flows along the Continental Divide in northwestern Montana and turns northwest to join the Flathead River near Glacier National Park. The drainage basin above Hungry Horse Dam is 85 miles long and averages 20 miles in width. The area is mountainous and heavily timbered, elevations ranging from 3,120 ft at the dam to a maximum of 9,200 ft. Annual precipitation in the basin ranges from 22 in. to about 35 in. at the summit of the mountains.

The average flow of the South Fork near Columbia Falls, Mont., recorded for the past 17 years, is 2,986 cfs. The maximum recorded discharge, which occurred on June 19, 1916, was 46,200 cfs. A peak discharge of 58,000 cfs is known to have occurred in 1894. The maximum probable flood used as the basis for designing the spillway at Hungry Horse Dam has a peak discharge of 80,000 cfs and a 30-day flood volume of 2,096,000 acre-ft.

The foundation rock for the dam and appurtenant structures is Siyeh limestone, which contains appreciable quantities of clay, silica, and magnesia. As the foundation for an engineering structure, this rock is somewhat superior to purer limestones because its impurities have somewhat increased its hardness and greatly lessened its solubility. The beds are regular and range in thickness from a few inches to several feet.

The foundation rock is cut by one major and several minor shear zones and by one major bedding-plane slip. The clayey material in the bedding-plane seam was washed out by drilling vertical holes in a suitable pattern, and was replaced with grout. The major shear zone, ranging from 8 to 20 ft in width in the foundation area, strikes northeast across the dam foundation and dips steeply toward the southeast. This zone is being effectively sealed by cutoff shafts at the upstream and downstream toes of the dam. The shafts are washed with high-pressure air and water, backfilled with concrete, and sealed by high-pressure cement grout. These concrete cutoffs, 100 to 200 ft deep, provide a percolation distance along the contact surface of concrete and crushed or sheeted material of not less than $2^1/_2$, nor more than 4 times the hydraulic head between the maximum reservoir water surface and the minimum tailwater surface, or the toe of the dam.

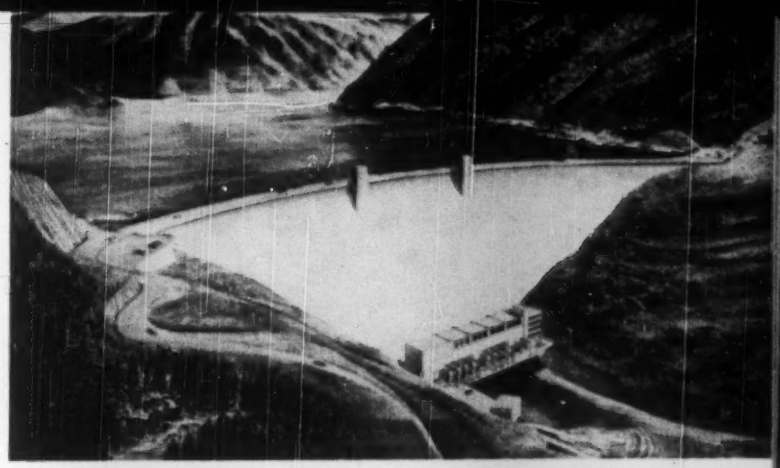
The layout of the required foundation excavation specified that the contours of excavation be on radial lines in so far as practicable and economical to obtain. All the bedding planes have the same dip. Besides dipping steeply from left to right, they also dip slightly in an upstream direction. For this reason it was necessary to cut through the strata between bedding planes parallel with the axis of the dam on the left abutment to obtain uniform radial foundation contours.

Design by Trial-Load Method

Hungry Horse Dam was designed as a variable-thickness structure having a vertical upstream face and half radial abutments. The cantilevers—vertical radial elements of the structure—carry a large part of the load as the canyon is V-shaped with rather flat slopes on each side (see Fig. 2). The upstream face was made vertical to take full advantage of the dead weight in reducing cantilever stresses when the reservoir is full. The variable-thickness layout was chosen to give a better distribution of stress and economy in concrete yardage, and the abutments were made half radial so that the resultants at the arch abutments would cross the excavation contours at an angle as near 90 deg as possible to give maximum stability without excessive rock excavation.

The dam was designed by the trial-load method. The analysis included the following loading conditions: (1)

FIG. 1. HUNGRY HORSE DAM on South Fork of Flathead River is one of major components of expanding power network which includes Bonneville and Grand Coulee Dams and will also include McNary and Chief Joseph Dams now under construction by Corps of Engineers.

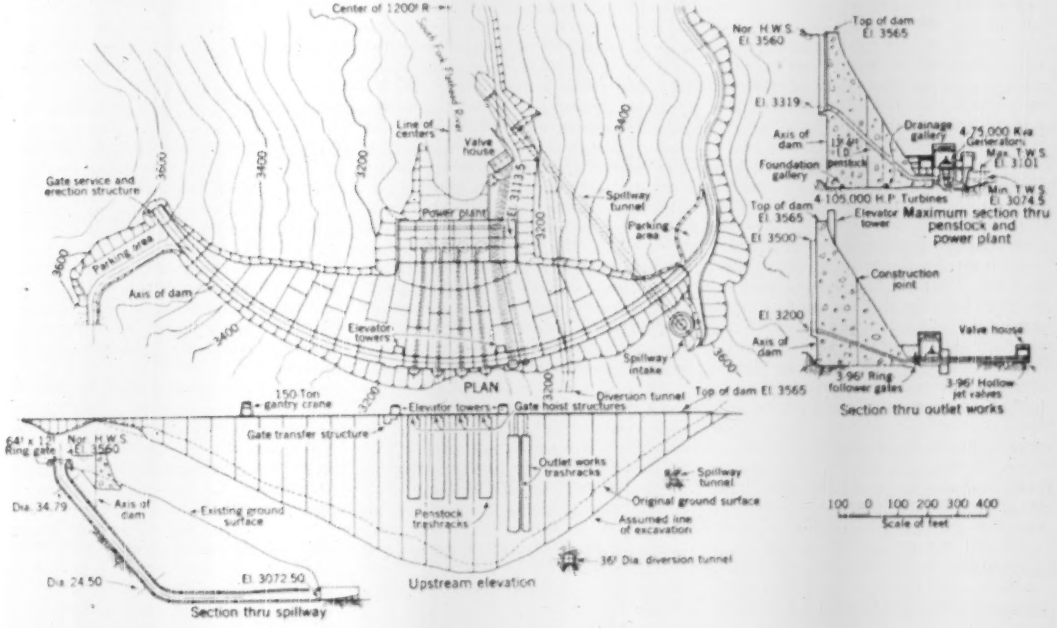


CONSTRUCTION PROGRESS on Hungry Horse Dam in current season has reached record of 152,000 cu yd of mass dam concrete placed in July. Dam was begun in June 1948 and is scheduled for completion in November 1953.

Reservoir water surface at El. 3,560, (2) a $2^1/_2$-ft-thick ice sheet exerting a pressure of 5 tons per lin ft, and (3) earthquake acceleration acting upstream along the line of centers with an intensity of 0.1 that of gravity. The arch and cantilever stresses parallel to the upstream and downstream faces of the dam are given in Fig. 3. The maximum computed compressive arch stress, 406 psi, occurs at the right abutment intrados at El. 3,300. The maximum computed tensile arch stress, 38 psi, occurs at the crown intrados at El. 3,150. The maximum computed cantilever stress, 545 psi compressive, occurs at the downstream face at the base of Cantilever E. No tensile stresses occur in the cantilevers. The maximum computed compressive principal stress is 731 psi, and occurs at the downstream left abutment at El. 3,200. The maximum computed tensile principal stress is 30 psi, occurring at the upstream right abutment at El. 3,450.

The circular spillway crest is controlled by a ring gate having a centerline diameter of 64 ft and a maximum lift of 12 ft. A similar ring gate has provided successful control for the spillway of the Reclamation Bureau's Owyhee Dam in Oregon. The top of the gate will be at the normal high reservoir water surface when in the raised position. This gate is a closed, watertight, annular ring which is to be raised by buoyant force. Gate movement is manually controlled by variation of the water level in the gate chamber. The gate is held in alignment by sets of double pinions which

FIG. 2. PLAN, ELEVATION, AND SECTIONS through Hungry Horse Dam and spillway show design of concrete arch of variable thickness to fit V-shaped canyon.



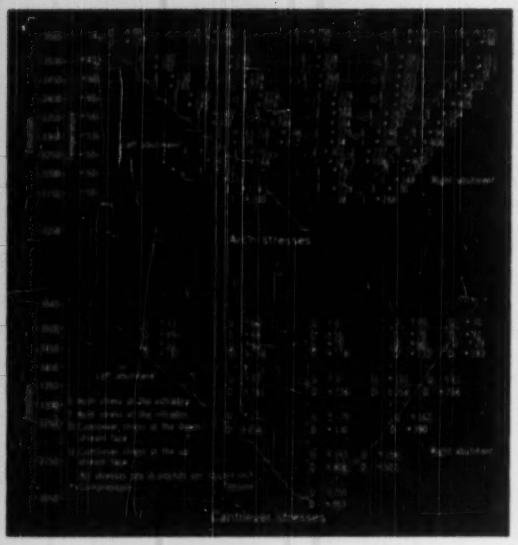


FIG. 3. DIAGRAMS show results of computations of arch and cantilever stresses for Hungry Horse Dam.

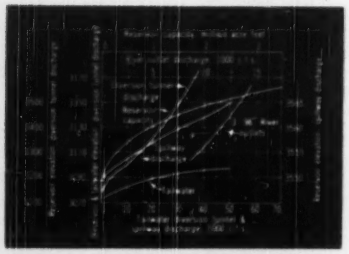


FIG. 4. CURVES (right) show discharge of spillway, diversion tunnel, and river outlets at various reservoir and tailwater levels.

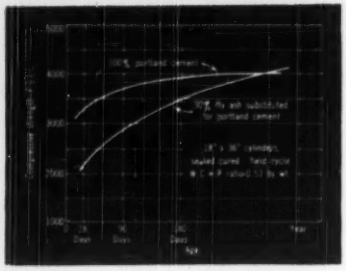


FIG. 5. Compression tests (right) of concrete show that substitution of 30-percent fly ash for portland cement gives decreased strength at 28 days but slightly greater strength at age of one year.

engage beveled racks anchored to the concrete walls of the gate chamber. Drains having flexible joints are attached to the gate bottom to provide interior drainage of the gate if needed. The inner and outer circumferences of the gate are to be sealed by combination rubber and metal seals between the gate and the crest structure. A system of air nozzles supplied by a compressor will be provided around the structure to keep ice from forming.

When the ring gate is in the lowered position, the spillway discharge varies from free flow at low heads to orifice flow at higher heads (Fig. 4). The 37-ft-dia orifice located at the top of the upper tunnel elbow limits the maximum discharge to a head of 45 ft. The shape of the top of the gate and the interior of the concrete crest structure was determined from the shape of the under nappe at the maximum discharge, disclosed by hydraulic model studies. Smaller discharges and discharges with the gate raised, spring free from this surface shape and require aeration under the nappe. This aeration is provided by air vents under the lip of the gate, and by a concrete air duct which enters the top of the upper elbow. This duct will also supply air to the shaft and tunnel.

Choice of an inclined shaft instead of a vertical shaft was based on comparative economic studies. The shaft and tunnel were designed to flow partially full at maximum discharge with aeration provided from the downstream portal to the upper elbow. The shaft was tapered uniformly in diameter from 34.79 ft at the bottom of the upper elbow to 24.50 ft at the top of the lower elbow. The added cost of formwork for a tapered shaft, as compared with that for a shaft of uniform diameter, is more than offset by savings in the quantity of excavation and volume of concrete lining. Hydraulic model tests showed that an elbow of 120-ft radius gave suitable operating conditions.

The spillway outlet structure, downstream from the portal, maintains the 36-ft width of the tunnel. The floor is raised 13.5 ft by a long-radius curve and forms a vertical deflector which raises the high-velocity jet above the river tailwater and allows the jet to enter the river a safe distance from the structure.

Four penstocks of 13-ft 6-in. diameter run radially through the dam and enter the scrollcases of the 105,000-hp turbines in the power plant with a diameter of 11 ft 9 in. Each penstock is about 450 ft long and is embedded in the dam except for a short exposed section in the powerhouse (Fig. 2). The penstock intakes are protected by a trashrack structure.

The penstocks were designed for a total head of 570 ft, including static and water-hammer heads, under normal operating conditions, and for a total head of 671 ft under emergency conditions with a 4-sec closing. A design stress of 15,000 psi (one-half the yield point) was used for the head under normal operating conditions, and 20,000 psi (two-thirds of the yield point) under emergency conditions.

As all longitudinal joints of the penstocks were radiographed, a joint efficiency of 100 percent was used in computing the required plate thicknesses, which vary from $^{9}/_{16}$ in. at the upstream end to $1^{5}/_{16}$ in. at the downstream end.

As the size of the penstocks exceeded shipping limitations, it was necessary to fabricate the pipe in a field plant near the dam. About 1,575 tons of steel were required for the fabrication of the four penstocks. The stiffener rings were made from the same steel as the pipe shell. The rings were welded to the shell with continuous small fillet welds, and their ends were buttwelded to form continuous rings.

Four fixed-wheel gates are provided for emergency and service closure of the four penstocks. These 13.5 × 18.93-ft gates are of structural steel, riveted and bolted. They are mounted on the face of the dam

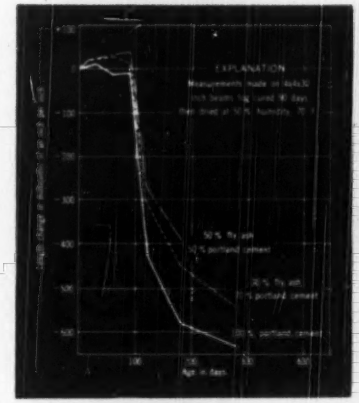


FIG. 6. LENGTH TESTS on concrete beams show that substitution of fly ash for part of portland cement decreases shrinkage over long period although shrinkage at age of 100 days is closely parallel for specimens containing all cement, 30 percent fly ash, and 50 percent fly ash.

VERTICAL FAULT ZONE is carefully prepared for sealing against percolation. Shafts at upstream and downstream toes of dam were washed with high-pressure air and water, backfilled with concrete, and sealed by high-pressure cement grout. These concrete cutoffs are 100 to 200 ft deep.

EXCAVATED LEFT ABUTMENT foundation shows exposed Siyeh limestone on which dam rests. Some concrete has been placed in four blocks in river channel (foreground). Step of concrete in highest block marks location of longitudinal joint in dam. Block sizes were made as large as possible for economy in formwork, cleanup and other factors. Blocks as large as 80×185 ft contain 2,700 cu yd in 5-ft lift.

and are operated by hydraulic hoists. Rubber double-wing, solid-bulb seals are mounted on all four gate edges and engage stainless-steel seats on the embedded structural-steel frames. Corrosion-resistant steel tracks for wheel travel are mounted on the same frames. The maximum design hydraulic pressure on each gate is 126 psi. Gate travel is $22^{3}/_{4}$ ft. The first $21^{3}/_{4}$ ft of gate closing is effected in $1^{3}/_{4}$ min, the last foot in 4 min, making the total closing time $5^{3}/_{4}$ min. To open the gate requires about 12 min.

Three 96-in.-dia outlet pipes from 688 to 704 ft long provide river control. The pipes extend radially through the dam and powerhouse to the valve house located at the river bank. The intake end is at El. 3,200 and the downstream end at El. 3,101. Trashrack structures protect the intakes.

The outlet pipes were fabricated in erection lengths of 30 ft, each encased or embedded section being stiffened by two $5\times{}^{1}/_{2}$-in. rings. Flow in the pipes is controlled by hollow-jet valves at the downstream end, and ring-follower gates in the powerhouse are used for emergency shutoff. The upper tangent of each outlet pipe is embedded in the dam; the lower horizontal tangent is exposed in the powerhouse and encased in concrete below that point. The exposed section of pipe is provided with an expansion joint of the double stuffing-box type to permit both vertical and horizontal movement.

Fly Ash Substituted for 30 Percent of Cement

One of the most extensive laboratory investigations undertaken by the Bureau laboratories for a single project covered the studies of the concrete to be placed in Hungry Horse Dam. These investigations included analyses of the concrete mix, compressive strength and elastic properties, heat of hydration, thermal properties, volume change, permeability, and durability. Over 1,000 concrete cylinders and bars were tested and analyzed during this work.

As a result of this comprehensive laboratory undertaking, which corroborated studies by others, 130,000 tons of fly ash, a pozzolanic material, are being used in the manufacture of the 2,900,000 cu yd of mass concrete for the dam. Fly ash is a waste product of combustion which is obtained from the flues of coal-burning furnaces. It is precipitated at the base of industrial smokestacks either by an electrical method or by centrifugal dust collectors.

Use of pozzolanic fly ash as a substitute for part of the portland cement has resulted in the following advantages: a saving in portland cement in a region where there is a scarcity; reduction in the cost of the structure due to lower cost of the fly ash as compared with portland cement; improved workability of the concrete; less segregation and bleeding; lower heat of hydration; and greater impermeability.

The tests indicated that the early strength of concrete is reduced in proportion to the amount of fly ash substituted for portland cement, but that concrete containing fly ash gains strength more rapidly than that without fly ash except at early ages. At later ages, about one year, the strength of concrete containing 30 percent of fly ash is about the same as that of concrete containing no fly ash (Fig. 5).

The tests also disclosed that fly ash does not contribute to autogenous shrinkage. This property is extremely important in planning the block grouting program to determine the age at which the greatest shrinkage occurs, and in evaluating the equivalent temperature stresses occurring within the mass. Concrete containing fly ash has slightly higher thermal coefficients of expansion than that without fly ash, and fly ash tends to decrease drying shrinkage (Fig. 6).

Contraction-joint spacing and construction requirements for Hungry Horse Dam, particularly the concrete cooling requirements, were interde-

Hungry Horse Dam

Type of dam	Arch
Relative size	World's fourth largest and third highest
Height	564 ft from lowest excavation of foundation
Volume, total	2,990,000 cu yd
Volume, placed	998,000 cu yd through Nov. 11, 1950
Reservoir capacity	3,500,000 acre-ft
Powerhouse	Four vertical 105,000-hp turbines, 75,000-kw generators
Cableways	Three 25-ton with combined capacity of 7,200 cu yd in 20 hours
Cement	70% portland, 30% fly-ash
Concrete placement	167,000 cu yd placed in best month, Sept. 1950, or 5,570 cu yd per day (6,800 cu yd per day max.)
Mixing plant capacity	8,000 cu yd in 20 hours
Work begun	June 1948
Completion scheduled	November 1953
General contract	$43,431,000
Materials furnished by Government, including cement	$13,639,000, estimated
Contractor	Twelve firms incorporated as General-Shea-Morrison
Designer	U.S. Bureau of Reclamation

pendent. In order to lower the cost of formwork, block cleanup, installation of grouting systems, and contraction-joint grouting, block sizes were made as large as possible consistent with the size of plant available for mixing and placing, without developing cold joints within the block.

As the base width of the dam is over 220 ft, at least one longitudinal joint was required to prevent the development of continuous wide cracks across the blocks during the period of exposure on top of the lift. The design requirement that the transverse contraction joints cannot be grouted until the temperature of the mass concrete falls to 38 deg F, which is several degrees below the mean annual air temperature, required that the concrete be artificially cooled with an embedded pipe cooling system during the construction period. Since an embedded pipe system was required throughout the entire structure to remove the excess heat, it could be made to serve, at a very slight increase in cost, the additional purpose of controlling the temperature rise of the concrete in the early stage. This early cooling permits a wider spacing of contraction joints than would otherwise have been permissible.

Cooling pipes are spaced 3 ft apart on the top of each 5-ft lift in the bottom of the dam. This spacing will be increased as the block lengths shorten until at the top of the dam it will be 5½ ft. All cooling coils are of thin-wall steel tubing with 1-in. outside diameter.

Transverse contraction joints are spaced 80 ft apart, the maximum spacing considered practicable for the 185-ft-long blocks. A wider block would be more likely to develop intermediate cracks between contraction joints at the top of the dam, where the thickness is 35 ft. The vertical contraction joints of Hungry Horse Dam thus break the mass into blocks as large as 80×185 ft, in which a 5-ft lift contains about 2,700 cu yd.

The transverse joints have vertical keys and the longitudinal joints, which are offset 50 ft in adjacent blocks, have horizontal keys so that all blocks are keyed together for mutual restraint against deflection and for transference of stress across contraction joints.

Placing temperature of concrete is sufficiently low at all seasons of the year so that it is not necessary to cool the aggregate or to substitute ice for part of the mixing water. The initial temperature rise is controlled by circulating the coldest river water available for 16 days immediately after each lift is placed. Cooling is discontinued after this 16-day period to assure that sufficient heat remains in the mass. Final cooling to 38 deg F before the joints are grouted will be accomplished during cold weather when the river water approaches freezing temperatures.

CONSTRUCTION—Concrete Poured at Rate of 6,000 Cu Yd per Day

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Office Engineer, U.S. Bureau of Reclamation, Hungry Horse, Mont.

START OF construction on the upper access road to the dam site on September 26, 1946, marked the beginning of major construction activity on the Hungry Horse Project. Since the award of this first construction contract, contracts have been awarded for the clearing of the reservoir, relocation of a part of the Forest Service's facilities in the reservoir area, and construction of the diversion tunnel. The principal $43,431,000 contract, covering construction of Hungry Horse Dam and Power Plant, was awarded in April 1948 to the General-Shea-Morrison Company. Contracts remaining to be awarded include the relocation of the remainder of the Forest Service's facilities in the reservoir, installation of the turbines and the electrical and mechanical equipment in the power plant, and major work on the dam and power plant not covered by existing contracts.

First construction activity at the dam site was the start of work on the diversion tunnel in December 1947, under a $643,400 contract awarded to the Guy R. Atkinson Company of San Francisco. This work was completed in June 1948. The 36-ft horseshoe-shaped tunnel, approximately 1,000 ft long, was driven through the right abutment to provide for the diversion of river flow during the construction of the dam. The top heading and bench method was used, the top heading being carried forward over the full tunnel section at a center-line height of about 10 ft. Both the top heading and the bench were advanced about 14 ft with each round fired. Muck was removed by a 1½-cu yd electric shovel dumping into 20-cu yd trucks. The tunnel was ventilated to clear out truck-engine exhaust gases.

Excavation of the glory-hole spillway tunnel, included in the prime contract for the construction of the dam and power plant, was subcontracted

to the Boyles Brothers Drilling Company of Salt Lake City, Utah. Because of experience gained from similar smaller projects, the subcontractor departed from conventional methods in excavating the tunnel and utilized a so-called "long-hole" procedure. The initial step of this procedure was the driving of a 9×11-ft-high pilot bore from the junction of the spillway tunnel with the diversion tunnel (which had already been excavated) to the top of the inclined shaft of the spillway, a distance of about 355 ft. (The location and profile of the diversion and spillway tunnels are shown in Fig. 1 of the preceding article by Mr. Puls.)

Drilling was done with drifters and stoppers installed on a truck-mounted jumbo. From the bottom of the inclined shaft to the glory-hole inlet on top, a distance of 550-ft, the pilot bore was changed in dimension to an 11-ft-wide by 5½-ft-high bore and timbered so as to permit the simultaneous passage of muck coming down the bore and men and materials going up, as shown in Fig. 1 on this page. The angle of the inclined shaft was sufficiently steep so that, after shooting, all loose material fell to the bottom of the inclined portion. From this point, the material was moved by slusher approximately 200 ft to a truck loader. The slusher consisted of a reinforced steel ramp which mounted a 75-hp double-drum hoist operating the 2-cu yd-capacity slusher bucket. The hoist dragged the loaded slusher bucket from the pilot bore up the steel ramp, and dumped the tunnel muck into trucks standing under the opening in the ramp.

When the pilot bore had progressed sufficiently, circular ring slots were drilled out to the full cross section of the design tunnel. These slots, approximately 18 ft wide, were cut at right-angles to the axis of the tunnel at approximately 110-ft intervals along the pilot bore. Diamond drills were then set up in these slots and the rock drilled around the designed perimeter of the tunnel, the holes running approximately parallel to the tunnel center line.

Drill holes were 1¼ in. in diameter and 50 ft deep, spaced regularly around the perimeter and equally spaced inside. The number of holes varied with the diameter of the spillway tunnel at any given section. Sections along the horizontal drift averaged 23 holes, but in the inclined shaft as many as 38 holes were used.

After the pattern was drilled completely between any two ring slots, the holes were loaded with 60-percent dynamite. Because the holes were so deep, Primacord was inserted to the full depth to insure complete detonation. Generally, the holes were shot in a series of three or four, those closest to the pilot bore being blasted first, and the remaining ones being detonated progressively outward. By this method the rock was always relieved toward the pilot bore, which prevented overbreak. A portable ventilation duct removed foul air trapped in the ring slots.

The "long-hole" method of excavation gave excellent results in the spillway tunnel. There was a minimum of overbreak around the perimeter, and in many instances the outside edge of the original diamond-drill hole remained clearly visible on the wall of the tunnel. The condition of the remaining rock was good, as indicated by its sound and comparatively smooth surface. Drilling and shooting were accomplished with the minimum number of machine setups—only eight ring slots were excavated for the total tunnel length of approximately 900 ft. The method also proved to be fast, as indicated by the fact that 28,000 cu yd of rock were excavated from the tunnel between August 30, 1948, and March 14, 1949.

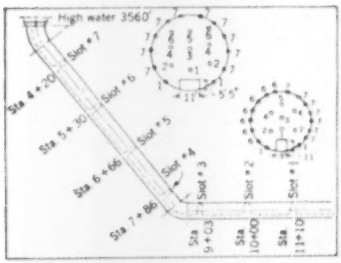
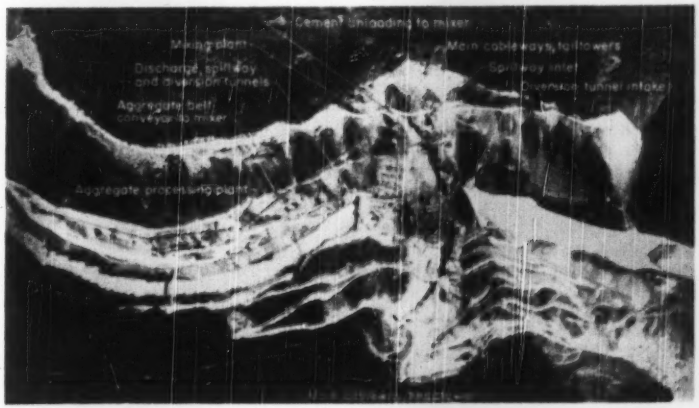


FIG. 1. GLORY-HOLE SPILLWAY tunnel was driven by unusual long-hole method. Diamond-drill holes 50 ft long were shot in sequence toward pilot tunnel.

CONTRACTOR USES four overhead cableways carrying 8-cu yd buckets to place total of 2,960,000 cu yd of concrete in dam from one central mixing plant.



Long-Hole Method Applied to Abutment Excavation

Excavation of the left abutment was accomplished by conventional breast and down-hole rounds. As the rock bedding planes paralleled the foundation, the cleavage plane of the rock could be controlled in drilling and blasting. However, some additional excavation was required for the removal of thin unstable planes, separated by decomposed rock and clay, to insure a sound foundation. In certain areas of the abutment it was deemed advisable to stabilize the overlying rock slabs and faults rather then excavate them.

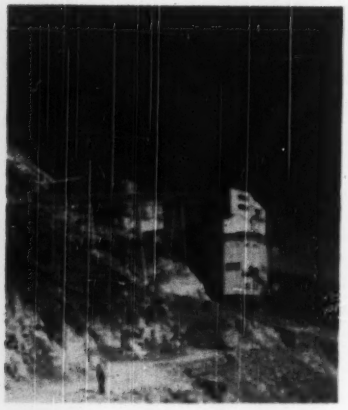
On the right abutment, the contractor was faced with a difficult excavation task because of the relatively steep slope of the natural terrain, and the close spacing of the right-angle joint planes in the rock. These conditions hindered access to the work and the placing of excavation equipment, and made necessary some vertical cuts of 60 to 70 ft. A large area of the abutment could be drilled with jackhammers only, as wagon drills on down holes could not be used satisfactorily. These short 10- and 12-ft down holes when shot generally resulted in a relatively rough, sometimes shattered and uneven surface which retained loose muck and hindered the loading and hauling of the excavated material.

To expedite the excavation schedule, the General-Shea-Morrison Com-

pany subcontracted excavation of certain areas of the right abutment to the Boyles Brothers Drilling Company, which had just completed excavation of the spillway tunnel as previously described. The same diamond-drill equipment and methods were used for excavating the dam abutment. The open-cut excavation method of using diamond drills was admittedly experimental but resulted in a satisfactory foundation in that shattering was minimized and regular cleavage of joint planes was made possible. Certain areas of the foundation, such as projecting ribs, were drilled from a single machine setup, thus saving considerable time normally lost in moving and erecting conventional equipment. Also, as compared with jackhammers and wagon drills, the diamond drills were set up farther apart on the slope, thus requiring fewer haul roads and less loading and hauling equipment for equivalent excavation yardage.

By the end of July 1950, the dam excavation was virtually completed; 983,000 cu yd of rock and 73,000 cu yd of common had been excavated. The remaining excavation will generally be removed by barring and wedging for final clean-up just prior to the placing of concrete.

BEDDING PLANES perpendicular to dam are uncovered in excavation for left abutment. Final cleaning of rock is accomplished by wet sandblasting and high-velocity air-water jets.



CONVEYOR BELT delivers processed aggregate to mixing plant. On upper slope are unloading shed and storage silos for cement and pozzolan. At top right can be seen trolleys for overhead cableway.

River Diverted Through 36-Ft Tunnel

In May 1948 a flood peak of 43,200 cfs, the largest flood on the South Fork of the Flathead since 1916, topped the contractor's cofferdams and resulted in the suspension of construction work for a period of 19 days. However, excavation of the dam was largely completed under the initial plan proposed by the contractor to construct cofferdams capable of diverting about 12,500 cfs, and during the 1949 and 1950 construction seasons, to allow flows in excess of that amount to flood the works. However, it become apparent that the operation of two of the four generating units at Hungry Horse Power Plant beginning in the fall of 1952 would materially aid in reducing the annual midwinter power shortage in the Pacific Northwest. To meet this new requirement, a revision of the proposed scheme of diversion as well as of the construction program and design of the power plant was adopted. It called for raising the upstream cofferdam by 43 ft so that at least 40,000 cfs could be passed through the diversion tunnel.

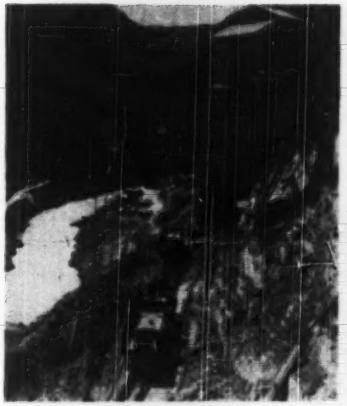
Closure of the diversion tunnel is scheduled for the 1951–1952 winter season, at which time the river flow will be passed through the three outlet tubes. Closure of the diversion tunnel prior to the 1952 spring runoff to provide 1,000,000 acre-ft of storage for downstream use in the following winter will require considerable accuracy in the prediction of total runoff for the 1952 water year. After the 1952 season no further difficulties in connection with diversion or flood flows are anticipated.

Under the revised plan of diversion, concreting operations at the dam were possible throughout the working season. At the start of the 1950 work year, 60,000 cu yd of concrete were in place in the dam. While 908,000 cu yd were placed in 1950, it is anticipated that 1,200,000 cu yd will be placed in 1951. The remainder of the concrete in the dam is scheduled for placement in 1952. Of this, 300,000 cu yd are to be placed before June 15 to meet the requirements of flood control and diversion and to obtain 1,000,000 acre-ft of reservoir storage in 1952.

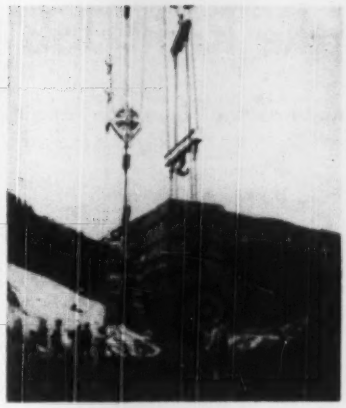
The first concrete in the Hungry Horse Dam was placed on September 7, 1949, and placing was continued until November 15 of that year. Cold weather in the Spring of 1950, accompanied by snow and ice, prevented resumption of major concrete placement activities until early April and hampered them for several weeks thereafter. By July, however, the contractor had reached a placement schedule of about 5,000 cu yd per day.

Suitable water for the concrete in Hungry Horse Dam is obtained from a mountain stream, and a number of suitable gravel deposits are located in the immediate vicinity. The main aggregate deposit is a 110-acre area 5 miles downstream from the dam site. Pit-run aggregate is excavated by a 10-cu yd walking dragline, loaded into 22-cu yd bottom-dump semi-trailers drawn by power units from 13-cu yd rear-dump trucks, and hauled 4½ miles to the processing plant. There the pit-run material is conveyed by belt from the receiving hopper to the primary screen, where oversize rocks are passed to jaw crushers and returned to the belt conveyor. The belt conveyor runs adjacent to a raw aggregate stockpile 800 ft in length. The belt is threaded over a number of staggered rollers on a stacker, which is moved on a track straddling the conveyor belt, and intercepts the aggregate at any desired point. Maximum estimated capacity of the stockpile is 400,000 tons.

Another conveyor belt running through a recovery tunnel under the raw aggregate stockpile carried the material into the main screening plant for complete processing. Aggregate is sized, washed, and if necessary, crushed to increase the quantity of the smaller sizes. The resulting aggregates are carried from the screening plant by conveyor belts and stockpiled by size over recovery tunnels. Two recovery tunnels are required because of the necessity for varying the blend of coarse, medium, and fine sand. The desired proportions of each grade of sand are removed from the stockpiles located over the short recovery tunnel and transferred to



DIESEL-powered hopper cars transfer concrete from 139-ft-high mixing plant to cableway buckets. Aggregate plant and stockpiles, contractor's shops, and Bureau field offices are on river bank in middle distance.



TWO 8-CU YD BUCKETS place concrete in long section near center line of dam. Vibrator crew stands clear for release of second bucket load. Four overhead cableways deliver buckets to work.

the blended sand stockpile located over the main recovery tunnel. Aggregates are moved out of the main stockpiles to storage hoppers over the mixing plant by conveyor belt. A final screening of the aggregate occurs above the storage hoppers. The aggregate plant has a capacity of 700 tons per hour, or sufficient to supply aggregate for about 7,000 cu yd of concrete per 20-hour day.

Mixing Plant Feeds Four Cableways

The mixing plant is located high up on the right abutment. Besides the final screening assembly, storage hoppers, and automatic batchers, it has a mixing deck holding five 4-cu yd mixers spaced in a circle and charged through the front end by a central rotating hopper. Four mixers discharge into one conical hopper, and the fifth mixer, used for special mixes, discharges into an adjacent hopper, both located to discharge through air-controlled gates into railway transfer cars.

Both cement and pozzolanic fly ash are delivered by rail to a siding $6\frac{1}{2}$ miles by road from the dam. Railway cars are unloaded into bins beneath the track of an elevated and covered siding. The bins discharge by bottom-hopper gates into weather-tight, metal semi-trailers of 880-cu ft capacity which are pulled by tractor units from 13-cu yd rear-dump trucks. The pozzolan and cement trailers discharge into covered receiving hoppers from which the material is transferred by belt conveyor to storage silos located above the mixing plant. The mixing plant is capable of producing about 8,000 cu yd of concrete in a 20-hour day.

Foundation surfaces of the dam are cleaned free of loose or semi-detached fragments, mud, debris, oil, or standing water immediately before the placing of fresh concrete. This cleaning is accomplished by whatever method is appropriate to the terrain and includes the use of equipment ranging from draglines to brooms. Final cleaning is accomplished by wet sandblasting and high-velocity air-water jets.

The horizontal surfaces of construction joints are cleaned of all laitance, loose or defective concrete, and other material before receiving fresh concrete. Cooling pipe and other items to be embedded in the new lift are installed and the wet sandblasting is started. Free material and debris are then flushed from the surface.

The concrete-placement system in use consists of three 25-ton-capacity cableways operating from a headtower on the left abutment to blanket the whole dam structure, except a portion of the left abutment, and part of the powerhouse structure. A fourth cableway of 20-ton capacity operates downstream from the main cableway system to handle construction of the rest of the dam structure and powerhouse. The three main cableways can handle about 7,200 cu yd of concrete in a 20-hour day.

Cableway buckets of several types are used for different classes and locations of concrete placement. The bulk of the concrete for the dam structure is handled in 8-cu yd buckets. These buckets, square in cross section, are suspended from the cableway by two sets of sheaves. These sheaves carry brackets attached to the sides of the bucket and the bucket-gate releases. By shifting the load from one set of sheaves to the other, the bottom-dump gate openings are controlled. A safety-trip release operated manually at the point where the concrete is to be placed prevents accidental unloading in transit.

Concrete placement is regulated to provide a maximum differential of 30 ft between adjacent blocks and 40 ft between the highest and the lowest blocks in the dam. Concrete placement in any block cannot exceed a rate of 5 ft of depth in 72 hours.

All horizontal surfaces to receive concrete are given a coating of mortar similar to the mortar in the regular concrete mixture. The water-cement ratio of the mortar cannot exceed that of the concrete to be placed on it. The mortar is mixed in the main mixing plant and transferred to the placement area in an 8-cu yd bucket. It is broomed across all horizontal surfaces before the regular concrete is placed.

Mass concrete is placed in successive layers of approximately 20-in. thickness for the full width of the block. Placement is started at the downstream end of a block and proceeds upstream the full width of the block only far enough to allow successive 20-in. layers to be applied until the full 5-ft height of the restricted placement area is reached. The slope of the unconfined upstream edges of the successive layers of concrete is regulated to minimize segregation and secure adequate compaction without unnecessarily enlarging the area of exposure of the fresh concrete. Placement of additional concrete is carried forward toward the upstream end of the block in similar progressive stages to the full area of the block.

Each layer of concrete is worked to satisfactory density by teams using two-man pneumatic power-driven vibrators. A one-man pneumatic auxiliary vibrator is used for consolidating concrete in small or inaccessible areas. All concrete surfaces are kept in a moist condition for a period of 21 days, or until covered by fresh concrete.

Engineering design and construction of Hungry Horse Dam are under the direction of L. N. McClellan, M. ASCE, Chief Engineer. Clyde H. Spencer is Construction Engineer for the project.

What Is the Right Job for Me?

After Finding an Answer to This Important Question, Engineering Seniors and Graduates Will Be Ready to Go About Getting the Right Kind of Job in a Businesslike Way

ALLEN P. RICHMOND, Jr., M. ASCE
Personnel Officer, ASCE, New York, N.Y.

FINDING A JOB after graduation should be a major concern of the engineering student during the last half of his senior year. The senior student will be wise to organize and carry out his job-seeking project as systematically as he would plan the construction of a building or a bridge.

The two most important decisions are in regard to the *function* or kind of work and the *field* of work desired. The two chief *functions* of civil engineers are design and construction, but various other functions, such as research, development, inspection, sales or promotion, cost accounting, and expediting are followed by many with satisfaction. Typical *fields* of work are structures, hydraulics, power, irrigation, sanitation, highways, city planning. Fields overlap, and skills in one field frequently can be adapted to others but the engineer should be on the alert against too wide diversification.

The engineering upper classman should try early to develop a pretty good idea of what he wants to do. If the student has serious doubts, he might well consider taking a set of aptitude tests. The results may only confirm his own convictions but often they will open up new and unanticipated possibilities.

Next the student should look beyond beginning jobs toward "what I want to become." Is it a builder (supervisor of construction or contractor), or a designer (chief of a design section or consultant), a planner, analyst, or what? It is not always possible at once to obtain the precise kind of work desired, but obviously the man with a goal will be more purposeful and will make better job decisions than the drifter without a career plan.

A Small Firm or a Large One?

Another decision to be made is whether to seek work with a small firm or a large one. Each has its advantages and disadvantages. The small firm may offer an earlier chance to use a diversity of skills and the young employee may be given responsible work sooner. Usually there will be a closer relationship between employer and employee, and the opportunity to learn about the business may be greater.

Since the big jobs go to big firms, an employee of a large engineering company will generally work on more spectacular and perhaps on more complex problems. Sometimes his work will be more specialized, but if the company rotates its engineers in various types of jobs, he may obtain as great a variety of experience, or more, than with a smaller firm. Successful experience with a large firm is widely recognized and may weigh heavily in applying for future jobs.

The mere size of a company is not a reliable indication of continuity of employment. Smaller firms are more likely to be interested in the smaller projects, of which there are a greater number. The fewer large firms are usually interested in the fewer large projects. Know-how in its particular field, soundness of judgment in planning and administration, and strength of financial backing are more likely to keep a firm busy, than size alone.

Nearly half of all civil engineers work for some public agency—federal, state, regional or municipal. Advancement in a public organization is seldom spectacularly rapid but for a good man will be steady. Some employees in large public organizations tend to become highly specialized, which may be very satisfactory for a life-long career but a handicap in shifting to another organization. The civil service system cannot respond as quickly as a private firm to outstanding performance by an employee but the civil service employee is more likely to be kept on the payroll during slack times, although he can legally be dropped any time his job is abolished.

Some public agencies feel that the relative security of their jobs justifies lower salaries than are usually paid by private firms. The young engineer should remember that the only real security is within himself—in his own ability and his own confidence that he can make good.

Starting the "Search Project"

After the decision has been made as to field and type of work, the actual search project can be started. Various mediums are available for getting in touch with prospective employers, including contact with the college Placement Officer, inquiries among employers or employees personally known (especially alumni of the college), registration with the Engineering Societies Personnel Service (forms from ESPS, 8 West 40th Street, New York 18, N.Y.), or with other employment agencies, contact with various civil service commissions,

Suggested Content of Personal and Professional Record

(To accompany letter of application)

Name	Date
Mailing address	Telephone
Age	Location acceptable
Height	Will you go out of town?
Weight	Will you travel?
Marital status	Member Engineering Society
Children	Grade
Citizen,	Registered Engineer, State(s)
Languages	Available to start work
EDUCATIONAL RECORD	
College	Year graduated
Major subjects	Degree Honors
MILITARY RECORD	
EXPERIENCE RECORD	(If practicable, attach a small photograph.)
OUTSIDE INTERESTS AND HOBBIES	

correspondence with prospective employers not personally known, and personal calls on likely firms. The applicant should also read the job advertisements in engineering periodicals and in newspapers. Two of these mediums are especially valuable—the college placement office and the student's own professors.

Firm names and addresses, especially of consulting engineers, will be found among the "professional cards" in the back of CIVIL ENGINEERING, *Engineering News-Record*, and other periodicals. For construction firms the annual July issue of *The Constructor*, published by the Associated General Contractors of America, Inc., should be consulted. *Engineering News-Record* and some other periodicals list construction jobs contemplated or under contract.

The Letter to Prospective Employers

The letter to prospective employers should be drafted and checked with someone competent to critize it constructively. It should tell what the writer has to offer from the point of view of the firm. A good grade of bond paper should be used, standard letter size, $8^1/_2 \times 11$ in. The letter should be accompanied by a brief statement of biographical and professional data (see box for suggested content), reproduced by some process that will produce a favorable impression. A small photograph should be included.

If the search project is to be initiated by correspondence the letters should be dispatched well before final examinations. All replies in which the company expresses some interest should be acknowledged scrupulously, and invitations for an interview should be complied with as soon as practicable.

The personal interview is the most critical phase of getting a job. All other exchanges of information are supplementary to it. The applicant should obtain some information about the company and its business in advance of the interview. He should then marshal his ideas as to why he would like to work for that particular company, and what he thinks he can contribute to it, not in terms of grandiose ideas but in terms of his development to date, his apparent abilities and special interests that may be useful to the company. A good test is for the applicant to put himself in the place of the interviewing officer and ask himself how he would hope that the applicant would look and act as a prospective addition to the staff.

Don't forget, if you are unsuccessful in your interview with one firm, to ask whether they know of any likely leads. Sometimes a second or third referral of this type will be successful when the primary list was barren.

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Self Appraisal Blank. ECPD, 1934. (Prepared especially for young engineers who have had a year or two of experience, but is of interest to others. Many older engineers say they would have given a good deal for such a document in their earlier years.) Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N.Y. 10 cents.

Should I Work Abroad?

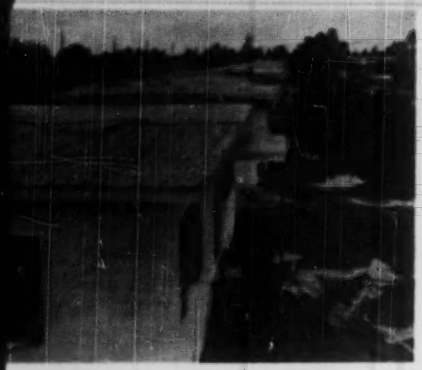
Foreign work can be rewarding for the engineer with the right temperament working for an experienced firm. Some previous experience is usually required. Most of the major firms that perform work abroad have placement offices. The *Engineering News-Record*, 330 West 42d Street, New York 18, N.Y., has prepared a list of American firms that are working or have done work abroad, and will send a copy on request. For U.S. Government jobs abroad, consult the Federal Civil Service, Washington 25, D.C.

A new graduate, however, should not make a casual decision to work abroad. First he should force himself to make an objective analysis of the advantages and disadvantages, making sure that his decision is not unduly influenced by the anticipation of glamorous aspects of life in foreign countries. The abilities and character traits of the individual desired for foreign service are exactly those that are most highly regarded for the best positions at home, perhaps with a little more weight on resourcefulness, initiative, and personal stability.

Ten Important Years Ahead

Let the new graduate remember that he is just on the threshhold of his career—that he really is a beginner—that he has acquired the best possible basic education on which to keep building while he gains experience. While he can be proud of his achievement so far, inevitably he will encounter rebuffs and criticisms, and he must use the latter to increase his value to employers and the former to bolster his resiliency in the business world. How he uses the next ten precious years will largely determine his career and his future happiness.

It may be a shock for the new graduate to discover that the world doesn't owe him a thing. In fact he owes the world something, as expressed some years ago by Ernest Martin Hopkins, then president of Dartmouth College. Dr. Hopkins was dissatisfied with the final words with which degrees were awarded, "with all the rights and privileges thereto pertaining," and changed them to read, "with all the rights, privileges, and *signal obligations* thereto pertaining."



CHIEF HURRICANE damage was to roofs of recently constructed small homes. In this new housing project, roofing was torn off although nails remained in place. Roofing materials littered this entire block of concrete-block houses with stuccoed exterior and poured concrete footings.

Miami Suffers Slight Structural Damage in Severe Hurricane

One of Florida's Worst Hurricanes Demonstrates Value of Building Codes Developed After 1926 Disaster

E. A. ANDERSON and HERBERT S. SAFFIR, Assoc. M. ASCE

Respectively County Engineer and Assistant County Engineer, Dade County, Miami, Fla.

THE HURRICANE of October 17, 1950, has the dubious distinction of being one of the worst in Florida history. It struck the Greater Miami area with a force almost as severe, although not of as long duration, as the great 1926 hurricane which caused such havoc.

Percentage-wise, the 1950 hurricane caused damage only to an estimated 0.3 percent of the total number of buildings. In contrast, the 1926 hurricane damaged 80 percent of the structures in the area. These percentage figures indicate that South Florida is much better prepared for hurricanes today than in 1926, when hurricanes were an unknown quantity. To the writer's knowledge, major buildings suffered no structural damage worthy of note in the 1950 hurricane.

Costwise, the 1950 damage has been assessed at from 14 to 17 million dollars in the Greater Miami area. This area takes in about 23 municipalities in Dade County, and includes Miami and Miami Beach. The damage caused in the City of Miami Beach alone has been estimated at 9 million. These figures are rough at this writing; total damage may run higher when insurance adjusters complete their studies.

Small Houses Suffer Roof Damage

Damage in the area, although running into millions of dollars, was generally not structural, but ranged from window-pane breakage to radio-tower destruction. Damage to roofs of smaller residences erected since the war was high. Percentagewise, however, even this damage was low. Only an extremely small percentage of the half million people dwelling in Dade County experienced any actual damage.

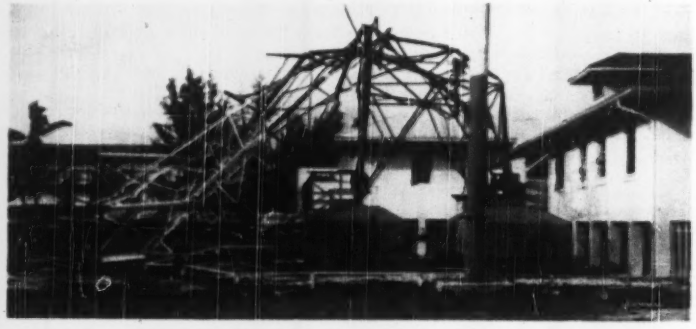
Most roof damage was confined to built-up roofs and tile roofs. Tarpaper was rolled up by the force of the storm and blown off residences. Gravel flew off roofs under the lashing of the winds. Purely structural failure was small—the structural framing of some roofs was damaged and occasionally it was noted that rafter anchorage failed.

Investigations of Roof Damage Made

A good deal of the roof damage was centered in veterans' housing projects, and a storm of reproaches and recriminations was directed at everyone from building officials and government officials to developers, general contractors, and subcontractors. Although roof damage was severe in some veterans' housing projects, it is interesting to note that expensive apartments in the so-called "Gold Coast" section along the beaches also suffered considerable damage.

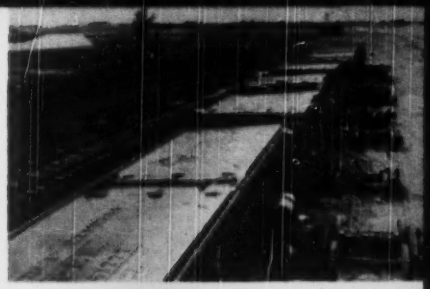
Building officials, local architects and engineers, and government engineers immediately began investigations of roofing damages. Although incomplete at present, the over-all picture indicates no gross negligence on the part of building inspectors, contractors or subcontractors. In most cases damaged residences appear to have been constructed in conformance with local codes and government specifications. In some instances roofing was destroyed that was fastened down even more strongly than the codes specify.

A major cause of roof failures was the insecure fastening of drip strips along the edges. Such strips rolled up in some places and allowed the wind to get under the roofing and tear it loose. In some cases the spacing of roof nails exceeded the allowable



TOWER of Radio Station WQAM was crumpled by hurricane although foundation remained firm. It is impossible to state definitely how tower failed but failure appears to have been started by buckling of individual members. This tower was free-standing. Several guyed towers withstood the storm without damage.

TWO RADIO TOWERS of WQAM in Biscayne Bay were destroyed in 1950 hurricane. This tower, like its mate, had withstood several previous hurricanes.



EMPTY FREIGHT CARS, overturned in yard of Seaboard Railroad, offer means of computing force of wind. Using weight and dimensions of cars, minimum unit pressure required for overturning was found to be 52.0 psf. Freight yard is in extremely open location, at Miami International Airport. Airport control tower in background was not damaged but some airport buildings suffered. Railroad yards are now being relocated as part of the Dade County Airport expansion program.

code limit and resulted in loss of the roof. Mortar used for fastening barrel tile on some roofs gave evidence of not being the proper mix. However, in most cases of roof damage, code requirements do not appear to have been neglected. Final statements on these points await the conclusion of investigations now being made by county, city and federal government officials.

Free-Standing Radio Towers Failed

Structural steel radio towers in general suffered damage and at least eleven were completely destroyed. From the appearance of the mangled wreckage, it is impossible to state definitely how these towers failed, but failure appears to have been started by the buckling of individual members. No towers failed by overturning of the entire structure. In one case—in one of the smaller municipalities—the writers know of a tower which was not designed for the design wind pressure called for by the code. This tower collapsed, but it appears to have been the only grossly underdesigned structure. Free-standing towers appear to have suffered more than guyed towers. Several guyed towers withstood the force of the hurricane without damage.

Drive-in theater screens in the path of the storm, with large vertical areas exposed to the wind, suffered no structural damage at all. No attempt was made to study the orientation of these screens with the wind direction. Possibly the maximum wind pressures were not normal to the exposed surfaces.

Ocean-front cabanas along Miami Beach, exposed to the brunt of the storm, suffered very extensive damage. Although there was no real structural damage to major buildings, occasional window panes blew out in the course of the storm, causing damage from rain, as well as sand in the case of beach-front hotels.

Wind Velocities Over 150 mph

Discrepancies exist between various readings of maximum wind velocities occurring in this hurricane. The recording anemometer on top of the Ingraham Building indicates a maximum sustained velocity of over 150 mph (miles per hour) for approximately a 15-minute period before the center of the storm reached the instruments (Fig. 1). This particular anemometer does not register readings over 150 mph, but it is safe to assume that gusts of wind during the most severe period had velocities of over 165 mph. This anemometer is set at a height of approximately 230 ft. Readings taken at ground level would probably have been smaller. The lowest barometric pressure recorded at the center of the storm was 28.40 in.

Most of this area operates under the City of Miami Building Code, with the exception of the beach municipalities, which have their own codes. After the storm, emergency meetings were called by building officials to determine whether the extensive roof damage was caused by failure of the codes. The consensus of opinion seems to be that the codes generally are not at fault, although they do contain errors of omission, and that in future more careful attention should be paid to supposedly unimportant construction details.

The Miami code calls for careful anchorage of all roof rafters, and very few cases have been found where rafters and roof framing were severely damaged. Apparently the damage was mainly confined to what can be

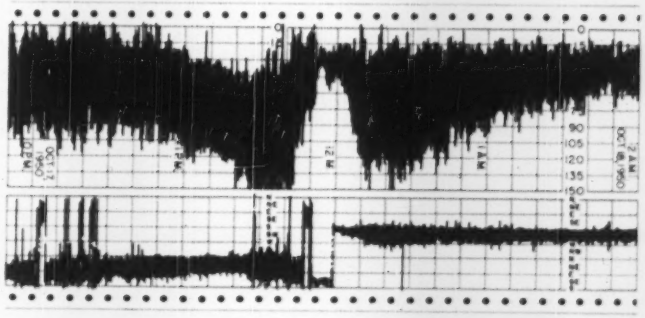


FIG. 1. RECORDING ANEMOMETER on top of Miami's Ingraham Building registered sustained velocity of over 150 mph for approximately 15 min. Lower chart shows wind direction, which reversed after calm eye of storm had passed. Besides moving forward, a hurricane rotates counterclockwise around calm center.

considered architectural details in roof construction.

There was no structural damage corresponding to that caused by the hurricane of September 17 and 18, 1926, the effects of which were described in the ASCE TRANSACTIONS for 1931, in the Structural Division Committee report, "Florida Hurricane." It is evident that one of the lessons of the 1926 hurricane had been well learned. This lesson, to quote from the report just mentioned, was that "adequate wind bracing is necessary in the construction of a building. Details must be carefully designed for the same strength as that for which the main members are calculated." Buildings that were properly designed for only a 20-lb wind load withstood the 1926 hurricane without severe structural damage.

Wind Pressures in Miami Code

The wind pressures used in the Miami Building code, established after the 1926 hurricane, are as follows:

Sec. 2307. Wind Pressure. For purposes of design the wind pressure upon all vertical plane surfaces of all buildings and structures shall conform to the following table:

MAXIMUM HEIGHT ABOVE GROUND	NORMAL WIND PRESSURE OVER ENTIRE HEIGHT
25 ft	25 pounds per sq ft
75 ft	35 pounds per sq ft
Over 75 ft	45 pounds per sq ft

(*a*) Buildings and structures whose height does not exceed one and one-half ($1^1/_2$) times the least width, need not be designed for the wind loads tabulated above. This exception does not apply to buildings and structures in which the width is a single structural span or in which the interior construction does not materially contribute to the lateral rigidity of the structure.

(*b*) The wind pressure upon sprinkler tanks, sky signs, or other similar exposed structures and their supports shall be taken as not less than fifty (50) pounds per square foot of the gross area of the plane surface, acting in any direction. In calculating the wind pressure on circular tanks, towers or stacks this pressure shall be assumed to act on six-tenths ($^6/_{10}$) of the projected area.

(*c*) The overturning moment resulting from the above calculations shall in no case exceed fifty (50) percent of the dead-load resisting moment.

The present code is under revision and it is anticipated that the revised code will give attention to such matters as wind loads on arched roofs, suction pressure and internal pressure on flat roofs, etc. However, the present code definitely insured structural safety in the past hurricane, since the major part of the damage covered so-called minor details of roof construction.

It is interesting to note that a wind velocity of 150 mph would indicate a pressure of 74.3 psf (pounds per sq ft), based on the equation, $p = 0.0033V^2$, in which p equals the total combined force on the windward and leeward faces of an average building, and V is the wind velocity in miles per hour. Based on the same equation, a wind velocity of 165 mph would exert a pressure of almost 90 psf.

An actual computation of wind pressures exerted by the hurricane was made possible by the fact that several empty freight cars standing on a level stretch of track at the Seaboard Railroad Yards were overturned by the wind. Since the weight and dimensions of these cars are known, it is possible to compute the amount of force barely necessary to shift a car into a condition of unstable equilibrium. This force divided by the square feet of longitudinal area exposed to the wind gives a unit pressure of 52.0 psf. This pressure, of course, is the *minimum* required for overturning; it gives no indication of the *maximum* wind pressures exerted by the storm.

Some engineers and building officials believe that tornado action was experienced in this particular hurricane. Grady Norton, in the U. S. Weather Bureau publication, *Florida Hurricane*, states that nearly all the hurricanes that have visited Florida have had tornadoes associated with them. The tornadoes occur in the outer edge of the hurricane circulation and not near the central vortex, he states. These tornadoes have had rather short paths but the destruction in the areas covered has been extremely severe. However, the U. S. Weather Bureau has made no official statement on the presence of tornadoes in the October 1950 hurricane.

Ivan Ray Tannehill in his authoritative book, *Hurricanes, Their Nature and History*, states that "There are few authentic records of tornadoes or violent local storms of tornadic nature occurring within a hurricane. . . . Winds of the tornado possibly attain velocities as high as 500 mph. . . . Occurrences of tornadoes in hurricanes in the United States in recent years have been confined to the State of Florida; they have been observed only in the northern semicircle of a hurricane passing through the Florida Straits or over extreme southern Florida."

Lessons of the Storm

Although the investigations are not complete at present, the lessons taught by this hurricane are clear. Buildings in hurricane belts—whether in South Florida, along the Gulf of Mexico, or in the typhoon belt in the Pacific—should be designed and constructed with the thought of hurricane protection even down to the smallest flashing or roof drip-strip detail. Just as the 1926 hurricane taught a grim lesson and evolved a series of practical wind pressures for concrete-frame and structural-steel frame design in hurricane areas, the 1950 hurricane teaches the same lesson with regard to the construction details built into smaller structures.

It also indicates that building inspection departments must not gloss over inspections; inexperienced contractors and builders must be carefully checked in the field to safeguard the public. Rigid inspection and good judgment on the part of the building inspector are highly important. Many of the roofing failures in this storm can be attributed to the failure of building inspectors to maintain close over-all inspection during construction periods. Part of the damage can be blamed on the fact that there has been a shortage of building inspectors.

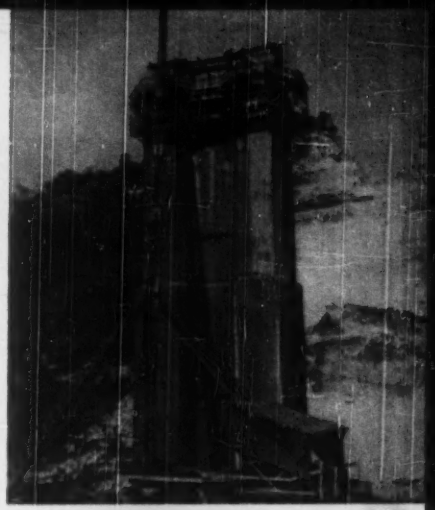
FOOTBRIDGE of steel and timber construction, on timber pile substructure, was wrecked in 1950 storm although it had withstood many previous hurricanes. This structure across Lake Pancoast has been a landmark in Miami Beach for many years.

OCEANFRONT CABANAS at a Miami Beach hotel were completely destroyed. Hotels themselves escaped damage except for some broken windows with consequent damage resulting from rain and windblown sand.

Slip Forms Reduce Cost of Tall Bridge Piers

RALPH HOLT

Resident Engineer, Modjeski & Masters; Cumberland River Bridge Project, Southern Railway System, Burnside, Ky.



SLIP FORMS were used with considerable success to construct tall piers of Cumberland River Bridge. Extra cost of concrete required for stepped design with parallel sides was negligible as compared to savings realized.

PREVIOUS EXPERIENCE has indicated that the use of slip forms is a most economical means of construction, particularly when form lumber costs are high. In order to utilize the slip-form method, the pier shafts of the Cumberland River Bridge were made parallel sided, with several steps to increase the width as required for stability. For a description of other features of this bridge, see the article by J. B. Akers, M. ASCE, in CIVIL ENGINEERING for October 1950. The cost of the additional concrete required for such a stepped design has been proved to be negligible in comparison with the saving resulting from the use of slip forms.

The longest straight length for the heaviest section of the piers was designed as 83 ft. The over-all height of the highest pier shaft is 204 ft.

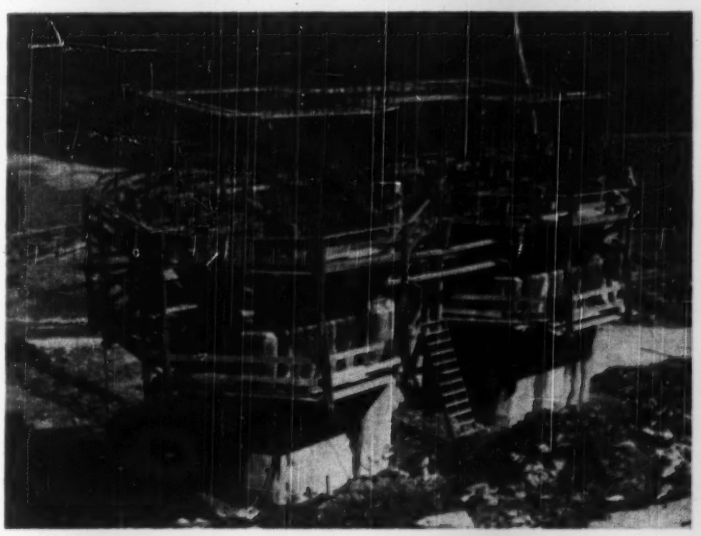
A typical form consisted of 1×4-in. tongue-and-groove dry lumber 4 ft long, backed by two rings of triple 2×8-in. wales. Transverse and longitudinal yokes across the top of the form and down the outside were secured to the wales by $^{3}/_{4}$-in. round rods and bolts, thus providing bracing and means for raising the form. Screw jacks, to raise the form, turned in threaded blocks secured in the yokes, and were clamped to 1-in. round vertical rods, which replaced vertical reinforcing steel. The number of jacks varied from 20 to 24, depending on the size of the form. A timber template was attached to the yokes and extended about 10 ft above the top of the form, to maintain proper position of jacking rods and vertical reinforcing steel. This template carried the platform for hoppers, chutes and workmen to receive concrete from the hoisting tower and to discharge it into the forms. Another working platform around the top of the form was used for jacking, placing reinforcing steel, inspection and general access to the work in the form. A third platform, carried about 4 ft below the bottom of the form, was used for concrete finishing and checking alignment.

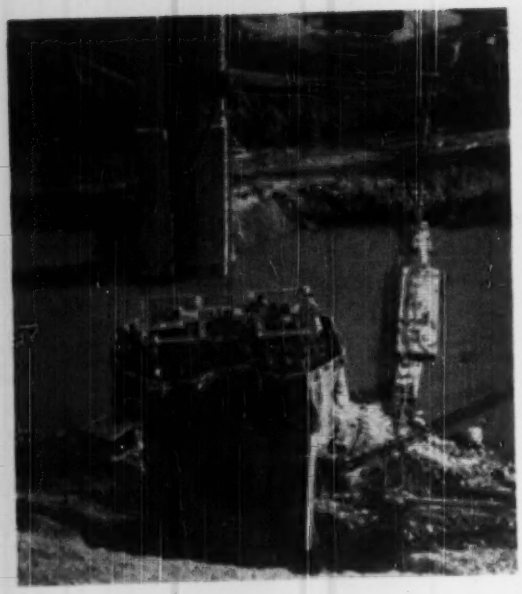
Concrete was deposited in the forms in two ways. On the lower sections of the shafts, the concrete was carried from the mixer to the form by a concrete bucket handled by a crane or stiff-leg derrick. It was deemed advisable to discharge the concrete bucket into a hopper with an elephant trunk attached to eliminate the danger of depositing a large volume of concrete directly against the form and causing a form failure. The second method consisted of discharging the concrete directly from the mixer into a bucket inside a steel elevator tower. Hoisting equipment raised the concrete to a hopper attached to the tower above the form. The concrete was released from the hopper as needed and carried to the form through a swinging chute discharging into the chutes on the working platform. On Pier 1 a Pumpcrete machine carried the concrete across the river, through an 8-in. steel pipe. This pipe was supported on steel barges and discharged into a hopper at the pier site. The concrete was then deposited in the form by one of the two methods just described.

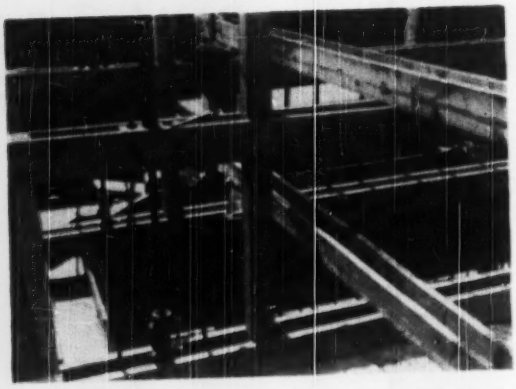
Form Kept Always Full

Best results were obtained by placing concrete at a rate which kept the forms full at all times. Since the

TYPICAL SLIP FORM consists of 1×4-in. tongue-and-groove timber 4 ft long backed by two rings of triple 2×8-in. wales. Template above top of form holds reinforcing and jacks in proper position besides serving as working platform. Another working platform around top of form is used for jacking and general work within form, while lower platform serves for finishing concrete surface. Photo courtesy Corps of Engineers, U. S. Army.







SCREW JACKS (above) used to raise slip form turn in threaded blocks secured in timber yokes which run across top of form. Jacks are clamped to 1-in. vertical rods which replace vertical reinforcing steel. Photo courtesy Corps of Engineers, U. S. Army.

CONCRETE is placed in slip form from hopper in steel elevator tower (left). Bucket carries concrete up to hopper from ground level. In lower sections of pier, concrete was delivered to form by crane and stiff-leg derrick.

forms were designed for a small amount of fluid concrete, it was necessary to keep the rate of pouring the same as the rate of jacking, even at the beginning of operations. From four to seven hours were required for the concrete to set sufficiently for the jacking operations to begin.

Generally, jacking of the form was started when the bottom 12 in. had set sufficiently, and was continued at such a rate as to have from 12 to 14 in. of hard concrete in the bottom of the form at all times. Hardness of the concrete was tested by pushing a $\frac{1}{2}$-in. steel rod down from the top and also by checking the exposed concrete at the bottom of the form. This depth of hard concrete in the form may appear more than necessary, but the jack rods on these pours carried considerable weight. As the pier shafts are large, the working platforms, templates and other equipment were necessarily heavy.

Concrete was consolidated by workmen who booted it into place. Power vibrators were not used because there was too much danger of injury to the concrete below the slip form. Generally, best results were obtained by placing the concrete with a 3-in. slump. Concrete with a 2-in. slump was used at times, but the placing cost increased with its use. Puddling sticks were used next to the forms to eliminate air and rock pockets.

Concreting by the slip-form method continued at intervals from April through December. The rate of jacking the forms was dependent on the temperature of the concrete as placed. In the spring, with no heat used on water or materials, the pouring rate was about 4 in. per hour. During the summer months, the rate was as high as $7\frac{1}{4}$ in. per hour. The last slip-form pour was made at the end of 1949 with temperatures ranging from 22 to 50 deg F. The water and materials were heated and the shaft was protected by tarpaulins hung from the working platform. Concrete reached the form at temperatures of 65 to 70 deg. The average rate of this pour was $7\frac{1}{4}$ in. per hour. The foregoing rates of progress are based on the total time which elapsed in a continuous pour between the entrance of the first batch into the mixer and the placing of the last batch in that particular form.

After a pour was under way, the rate for twelve hours reached 9 in. per hour, and $8\frac{1}{2}$ in. per hour for a 24-hour period. Breakdowns of machinery and raising of hoppers and chutes on the tower retarded progress from time to time. Under average conditions, the rate of pouring in this locality should average 7 in. per hour, or 14 ft per day. Heating of water and materials would be economical in cold weather.

Jacking the Forms

Jacking the form was quite simple; two to four men walked around the working platform giving the screw jacks a one-quarter to one-half turn, which raised the form $\frac{1}{4}$ to $\frac{1}{2}$ in. The speed and height of the turn depended on the rate of setting of the concrete. Level marks were set on the jack rods and pointers were attached to the form or yokes before jacking started. The pointers were securely fastened in position so the form could be leveled on a new reference line in case the old one was lost. The form had to be kept in a plane so that the individual jack rods were not overstressed. Plumb bobs hanging on the forms were used to check alignment against points brought up along the face of the pier. These points were checked about twice each day with a transit to insure their accuracy. Maintaining true position on the form required constant supervision since the form was constantly moving and was not anchored to fixed points.

Because of the large cross section of the bottom of the piers, the forms showed a tendency to act as separate units on each barrel and to lose their original cross section. After completion of two pier shafts, the contractor's superintendent decided to add trusses to the two sets of wales. These trusses stiffened the form materially and relieved a situation which had been of considerable concern to all connected with the operation. After the wales were trussed, proper alignment was obtained with much less detailed supervision.

At the beginning of a shaft pour with the slip forms, reinforcing steel

CROSS SECTION of piers is changed by adding smaller slip form above first form. On some piers, smaller cross section was obtained merely by cutting down original form to required size while it was still in position.

COMPLETED PIER SHAFTS (right) present uniform appearance with minimum of construction joints. Piers will carry double tracks of Southern Railroad over Cumberland River.

was placed in the usual manner. Horizontal bars were placed to the top of the form and added as the form was raised. Splicing of jack bars was staggered so that alternate screw jacks could be released and raised. Vertical steel was spliced at about 20-ft intervals, with about half the bars spliced at the same elevation. Reinforcing steel was raised to the working platform by crane or by a small Chicago boom attached to the steel elevator tower used to hoist the concrete. At the beginning of slip-form operations, it was necessary to caution the workmen to distribute the extra steel uniformly around the working platform, as the tendency was to place it all on one side. This unbalanced extra weight caused the form to leave the vertical alignment, since the working platform had quite a long lever arm against the form.

Very Little Finishing Required

The only finishing required was done with a wood float immediately under the form to repair any small depressions. After the crews became experienced in placing the concrete, finishing was an easy job requiring only one man.

A horizontal ring of perforated pipe was attached to the form for use in curing the concrete. The pipe was so hung that water was applied to the surface of the pier at the point where the concrete was changing from dark gray to white. Water from this pipe was sprayed continuously on the surface of the shafts for 10 days. Sections of rubber hose were added to the pipe as the pier increased in height.

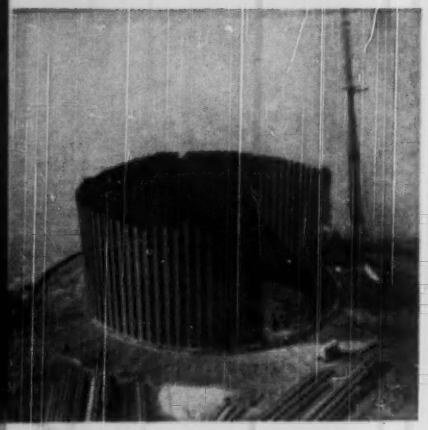
The crew used for the whole operation consisted of the following: 1 general foreman, 3 laborers in the cement house, 1 operator on the batching scales, 1 operator charging the batch plant, 1 operator on the mixer, 1 operator on the hoisting equipment; 2 oilers, 1 reinforcing-steel foreman, 2 rodmen, 1 finisher, 1 carpenter foreman, 2 carpenters, and 2 carpenters' helpers, 1 mechanic, 1 electrician, 1 truck driver, 1 foreman and 7 laborers placing concrete and jacking. The jacks were turned by laborers and carpenters' helpers. On small sections of the shaft, the number of men in the cement house was reduced to 2 and the placing force cut down, but the high-wage craft remained fixed. When the Pumperete machine was used, another operator and oiler were added. The above force was for one shift. The contractor worked three shifts a day.

When a point was reached at which the cross section of the shaft changed, work stopped until the form was cut down to fit the next section. Generally the form was cut down on the pier, although in some cases a new form was put up. About five days were needed in either case. The contractor had a set of forms for both Piers III and IV and to a certain extent was able to alternate the pours on these piers. The lower sections of Piers I, II and III were concreted with cranes or a stiff-leg derrick while the steel tower was being used on the top sections of other piers. No definite rotation of pouring was possible because concreting of the substructure and grading of the approach roadway were carried forward concurrently, making it necessary to schedule the work for definite periods to eliminate interference.

When a shaft had been concreted to the elevation of the bottom of the cap, the slip form was anchored to the shaft and used as a support for the cap form. Hoisting equipment used in concreting was also used to place grillage and anchor bolts.

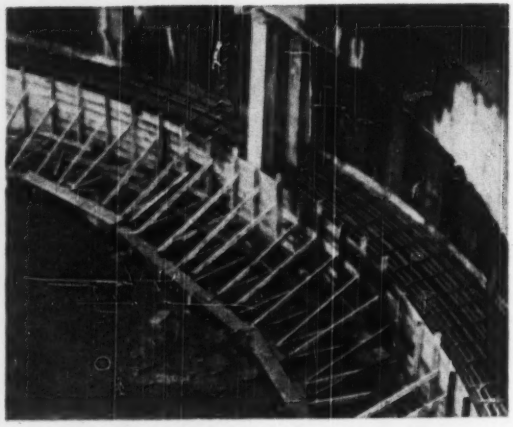
The completed pier shafts present a uniform appearance with a minimum of construction joints. The few construction joints required are not as noticeable as joints made with regular forms. In general, the alignment is more accurate than in heavy concrete masonry constructed in lifts with conventional forms. Close supervision and inspection of slip forming can maintain vertical alignment within very accurate limits.

Since the use of slip forms on bridge piers is recent and limited, excellent opportunities remain to reduce the cost of concreting by this method. The operation of changing the form for different cross sections presents one opportunity for cost reduction, and adjusting the plant and labor force to the rate of pouring presents another good opportunity for greater economy.



STEEL SHEETPILING is driven in circular cofferdam (left) for construction of water intake on Mississippi River. Foundation for pump well will be built in cofferdam.

STEEL RODS 1¼ in. square reinforce circular concrete wale in cofferdam (right). Unusual type of wale eliminates need for bracing across center of cofferdam, leaving area free for construction operations. Steel columns in center carry load of wales to bedrock.



Unique Cofferdam Foils Old Man River

GEORGE F. FLAY, Jr., M. ASCE

Drilled-In Caisson Corporation, New York, N.Y.

OLD MAN RIVER always seems to conspire against contractors—he never seems to cooperate. On one occasion we expected to float a pile driver into position. That was the year the river stayed at a record low. In the case here described the river made things difficult by varying from +36.5 to −5. (The extreme high recorded at the site was −47.2 and the extreme low was −6.5. Fortunately these records were not repeated during the construction here described.)

We contractors romanticize our jobs. We never have a job that is ordinary. Every job breaks some kind of record, either good or bad. Every job is either the best or the worst. This is particularly true when a project is on the Mississippi. The present project involved the construction of a water intake on the Illinois shore across from St. Louis, in a place called Venice, oddly enough. The particular problem was to provide an intake that would deliver 240,000 gpm regardless of the level of the river.

The intake was to supply cooling water for the Venice No. 2 plant of the Union Electric Power Co., which was constructed in four sections starting in 1940. With the installation of two 80,000-kw units in the fourth section, now nearing completion, the total installed capacity of the plant will be 400,000 kw.

The condensing-water requirements of the first three sections of Venice No. 2, as well as Venice No. 1, are supplied from intake caisson No. 1, originally built in 1925. Revised in 1942, the intake provided for an installation of four 105,000-gpm pumps, the maximum pumping capacity that could be installed in the original structure. With the installation of the two 80,000-kw units of the fourth section of Venice No. 2, additional condensing water supply was required. Therefore a new intake system with three 83,000-gpm pumps was planned. One of these pumps serves as a spare for the entire Venice No. 2 station.

Borings at the site indicated a stratum of silty sand extending down about 67 ft to a 15-ft stratum of igneous boulders, gravel and sand overlying rock. The rock is limestone in an advanced stage of metamorphosis, and quite hard although its top surface is weathered and laminated. Some boulders are encountered throughout the silty sand together with trees, old logs, and some sunken barges. On such a site construction of a pump well by the drop-shaft method involved many contingencies. A previous intake installed by the drop-shaft method had encountered great difficulty because of the boulders. Considerable effort and expense were entailed in controlling vertical alignment to permit installation of mechanical equipment. The new work was further complicated by the presence of old timbers, trees, and sunken barges at the site.

For this reason it was decided to build a cofferdam of steel sheeting extending down to about the top of the boulders. This cofferdam would

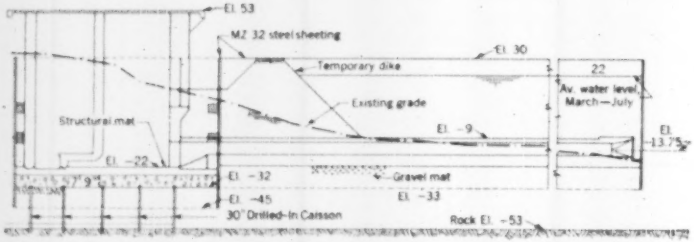
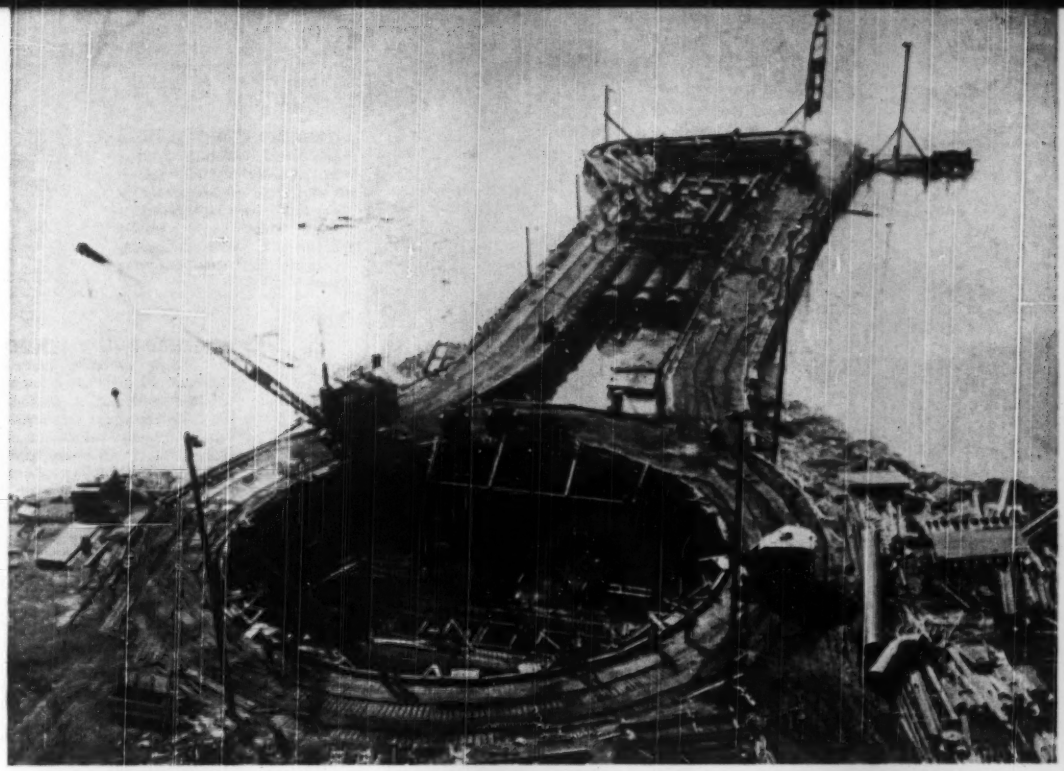


FIG. 1. ELEVATION of pump well and intake shows relative position of concrete wales, structural tremie mat and intake pipes. Load of concrete wales is carried to bedrock by rolled steel sections.



PUMP-WELL FOUNDATION RISES inside cofferdam while intake pipes and warming pipe, which will extend 240 ft out into river, are lowered into position. Pipes rest on Drilled-In Caissons and are completely encased in tremie concrete so that if river bottom is eroded, intake will not be endangered.

then be excavated subaqueously and, at a convenient level, Drilled-In Caissons would be installed to penetrate the boulders and the rock. The remaining excavation would be removed under water and an 8-ft-thick reinforced concrete mat would be poured by tremie to seal the cofferdam during construction and to provide a permanent slab upon which the pump well and the intake connections would rest.

Because of the wide variation in the level of the Mississippi it was necessary to extend steel tubes of 6-ft 6-in. diameter about 240 ft out from the shore so that their ends would be sufficiently submerged to draw water at the lowest stage of the river. Because of the abrasive action of the sand which the Mississippi always carries, it was necessary to encase the tubes in tremie concrete. The intake pipes, like the pump well, were supported on Drilled-In Caissons to protect them against the severe erosion expected at this site.

The pump well was constructed inside a 97-ft-dia circular cofferdam made of MZ-32 sheetpiles. The piles were driven from a circular trestle about to the surface of the gravel boulder stratum overlying the rock. The inside of the cofferdam was excavated by clamshell bucket to El. +4.0. Around the inside periphery of the cofferdam, on 30-ft centers, pairs of 12 BP 53 beams were driven to rock to support cast-in-place concrete wales that would take the entire compressive stress on the circular sheetpile cofferdam.

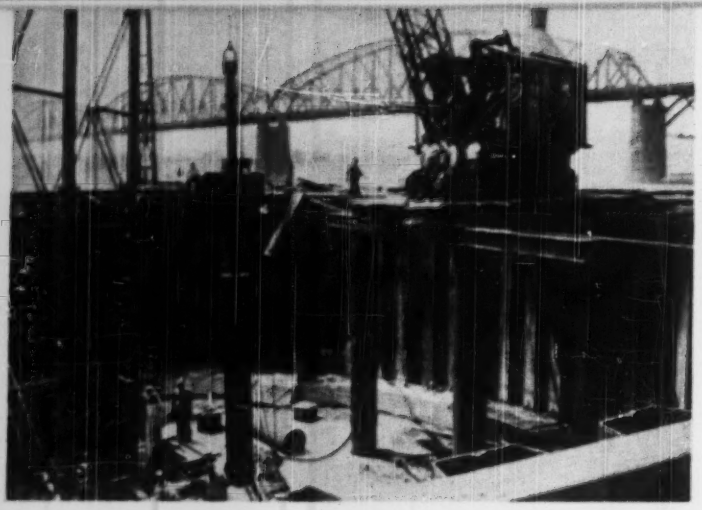
Circular Wales of Reinforced Concrete

The reinforced concrete wales were 4 ft high and 4.5 ft wide in cross section. They were designed on the basis of ring analysis, being reinforced to develop their full section in bending and to sustain their own weight between supports. Each wale contained 58 rods $1^1/_4$ in. square with $^3/_8$-in. stirrups on 18-in. centers. The top wale was formed and concreted at ground level using high-early strength concrete to expedite the work. Excavation was then carried 14 ft deeper and the second wale was constructed.

To reduce the differential head after the construction of the second wale, the cofferdam was backfilled to about El. +2. From this level, twenty 30-in.-dia Drilled-In Caissons capable of supporting a load of 1,140 tons and an uplift of 550 tons were installed. The caisson pipes were driven by a pile-driving crane using a No. 1 Vulcan hammer. Excavation inside the caisson was done by water jets followed by an oil-well type of drill rig using a 3,500-lb bit which churned through the boulders, allowing the cutting edge of the caisson to be driven to rock. A short socket was drilled into the rock and the caisson seated by further driving. Then a socket was drilled another 6 ft into the rock.

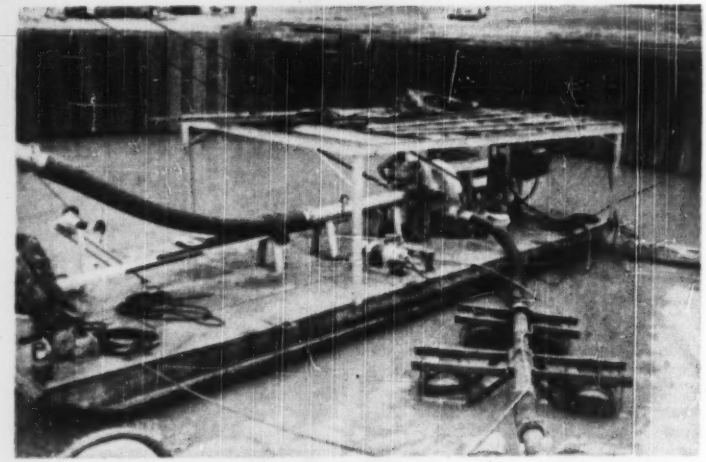
A 12 WF 53 steel core was lowered into the caisson and concreted in. The top of the core was at El. −26, the top of the tremie seal.

A dredge pump on a barge in the open cofferdam was used to excavate to El. −33, a depth of 63 ft from the top of the sheetpiles, after which the bottom was leveled and backfilled with 1 ft of broken stone. At this elevation, −32, the steel cylinders of the caisson were cut off by a diver using a submarine torch, leaving the H-cores protruding about 6 ft above the layer of broken stone in preparation for the tremie seal. A reinforcing cage of ten $1^1/_4$-in. square rods placed around the H-core gave added strength to the connection.



CRAWLER CRANE positions section of Drilled-In Caisson in partially refilled cofferdam. Load of pumphouse is carried to rock by these caissons, which were partially filled with concrete before pouring of tremie concrete seal.

COFFERDAM IS DREDGED to design elevation before sealing. Diver using submarine torch cut off Drilled-In Caissons under water just above planned elevation of tremie seal. H-cores protruded about 6 ft above broken stone bed.



Meanwhile, a reinforcing mat for the tremie seal was fabricated outside the cofferdam prior to lowering into position. This reinforcing, mainly $1^1/_4$-in. square rods, was assembled in sections connected to a steel form arranged to divide the tremie mat into three equal pours of 800 cu yd each. The steel was so arranged that as each segment was lowered into place, the rods projected far enough into the adjacent section to provide the standard bond splice.

The form consisted of two parallel rows of light gage steel sheeting, 26 ft apart, reinforced by angles and tie rods. Extreme care was taken in setting these forms. After each section was lowered, its elevation was surveyed by means of soundings and by rods previously welded to the reinforcing and extending above the water surface. At each end of the forms, hinged sections were provided in order to pass the wales.

After the entire form had been carefully placed, the hinged sections were positioned by the diver. Wherever openings were found around the form that would permit seepage of concrete, they were sealed by bagged cement.

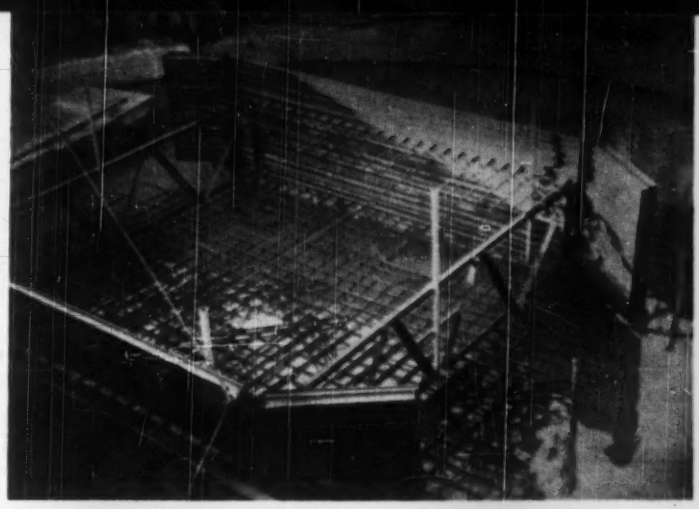
Special Method of Pouring Tremie Seal

The problem of pouring concrete under water is to place it in such a manner that a homogeneous mass results. Under field conditions it is impossible to pour concrete under water without some washing effect. This washing separates the fine particles of the cement, which then tend to flocculate and form an inert covering on the concrete. To keep washing to a minimum, concrete on this work was placed with a unique type of tremie pipe. This consisted of a small hopper welded to a piece of 18-in. pipe about 3 ft long, of diminishing diameter, which in turn was welded to a $10^3/_4$-in. pipe about 40 ft long.

A flap valve having a 12-in.-dia opening was welded inside the 18-in. pipe at its top. The flap could be closed by a cable passing through the hopper. Below the flap valve was a connection to an airhose, fitted with inlet and outlet valves. At the bottom of the $10^3/_4$-in. pipe, a flat plate faced with a $^1/_4$-in. rubber gasket was arranged to close the bottom of the pipe. This bottom plate was suspended from the pipe by rods in such a manner as to permit the plate to hang 10 in. beneath the pipe. Cables attached to the plate were brought up alongside the pipe to a pair of hydraulic jacks above water. The bottom of the tremie pipe could be closed by pulling up on the jacks and opened by releasing them.

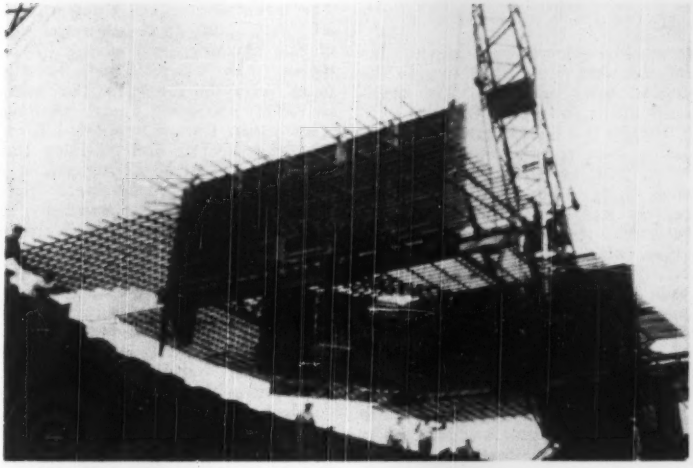
It was possible to fill the pipe with concrete without having the concrete come in contact with the water until the pipe was completely filled and ready for discharge. The procedure in starting a pour was to close the top flap valve, at the same time releasing the bottom plate. Air under pressure was allowed to enter the tube, forcing out the water. When air boiled up around the outside of the pipe, the bottom valve was closed and the pressure in the pipe dissipated through a relief valve at the surface. Water pressure forced the bottom plate against the end of the tremie pipe, producing a completely sealed pipe resting on the crushed stone blanket.

The tremie pipe was then filled with concrete to about the level of the bottom of the hopper. When the pipe was in position for concreting, the bottom valve was released by the hydraulic jacks and the tremie tube raised about 4 in., allowing the concrete to flow out from the bottom of the pipe. Flow was con-



HINGED SECTIONS of walls, dividing tremie pours, permit reinforcing mat to pass concrete wales. Final positioning of mats and walls was done by divers. Points of possible leakage were sealed with bags of cement.

STEEL REINFORCING MAT for tremie seal, seen from below, is being lowered into position after fabrication outside of cofferdam. Reinforcing was fabricated in three sections to permit three tremie pours of about 800 cu yd each.



trolled by raising or lowering the pipe.

The tremie pipe was hung in a headframe on a small steel skid, which obtained a 1½-cu yd collecting hopper. An air hoist was used to raise and lower the tremie pipe. Whenever the frame was to be moved, the same hoist was used to skid the rig along the top of the track beams which spanned the cofferdam. If continuity of placing was broken for any reason, the tremie pipe could be raised slowly until the bottom was clear of the concrete already poured. The air seal in the pipe was then reintroduced by repeating the steps described for the starting of the pour.

In the first pour of about 800 cu yd in the center section of the cofferdam, five tremie pipes were used, spaced along the center line at intervals of about 20 ft. The concrete flowed laterally 13 ft to the formed walls and 10 ft along the center line to meet the concrete from adjacent pipes. During the pour, soundings were taken and varying slopes were observed in the surface of the concrete, generally about 1 to 10.

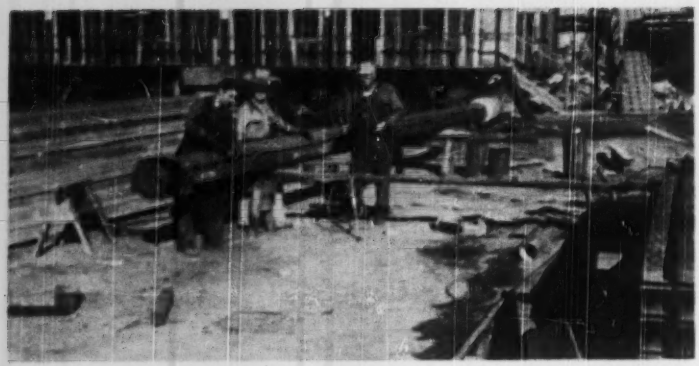
Concrete used contained 7 bags of high-early strength cement, 1,237 lb of sand, and 1,749 lb of 1½-in. gravel per cu yd, and was placed with a slump of 6 in. As the concrete neared the top of the pour, the tremie pipes were raised until their embedment averaged about 3 ft. It was found that, with a slope of 1:10, the concrete would be too low at the edge if it was poured only from the center-line location, so the tremie rigs were moved to positions 6 ft each side of the center as the pour neared completion. The hydraulic jacks were used to close the bottom valve, trapping the concrete in the tremie tube, which was then raised, moved horizontally to its new location, and lowered to continue concreting. Thus the seal was reestablished without the use of compressed air.

Continuous Pours Assured

Successful tremie pouring requires positive assurance of a continuous supply of concrete to avoid joints and thin, sloping layers of concrete that may permit structural failure. Such assurance was attained by establishing three sources of concrete. Mixed-in-transit concrete was delivered to a Pumperete machine on the bank that forced concrete through a pipe line to hoppers in the center of the cofferdam. Dry-batched aggregates and cement, from two separate plants, were delivered to either of two 27E pavers that discharged directly to hoppers above the tremies. A crane was available for bucket transfer of concrete from the pavers to the center hoppers if required, or the pump line could be extended to the exterior hoppers. Thus concrete could be delivered at sufficient rates even if a breakdown should cut off two-thirds of the supply.

The sheetpiles extended only 20 ft below the tremie concrete into material known not to be watertight. To check the uplift on the tremie seal and to serve as a safety device, if necessary, twelve 4-in.-dia bleeder pipes pierced the tremie concrete. These were left open while the cofferdam was pumped down.

When the concrete was exposed, it was found to be of uniformly excellent quality with small mounds at the tremie-pipe locations but otherwise reasonably level. There was about a 1½-in. laitance on the surface which could generally be removed by water jet if attacked immediately after unwatering. In a few hours laitance hardened so that a pick-axe was required for its removal.



TREMIE PIPE is fabricated at site. Valve at near end is actuated by hydraulic jack at upper end of pipe, and serves to prevent intrusion of water into pipe.

Flow from the open bleeder pipes was moderate and under very little pressure. If the water had been high, hoses would have been attached to the pipes and discharged over the cofferdam, and the valves would have been kept open to relieve pressure beneath the tremie mat. These precautions were not necessary as the Mississippi remained relatively low. Leakage through the Z-sheetpiles likewise was small. The equivalent of a 2-in. centrifugal pump working one-third of the time handled all the flow into the cofferdam.

Keys Cut in Tremie Concrete

The surface of the concrete seal was leveled and keys 4 in. deep and 1 ft wide were cut in a regular pattern over the entire area. Thus full development of shear was assured between the tremie concrete and the 2.25-ft-thick structural mat poured in the dry on top of it. The bleeder pipes were then grouted to seal them.

Above the structural mat, the 4- to 5-ft-thick horseshoe-shaped exterior of the pump well and the crosswalls partitioning the structure could be built without interference from cofferdam bracing of any kind. This arrangement permitted the use of large sectional forms, with great latitude in placement and maximum reuse of forms.

A single lift of panel forms with a maximum pour of 100 to 200 cu yd was selected with the objective of making one pour each day. Vertical construction joints were then located in the structure so as to permit scheduling the four major operations—form erection, reinforcing-steel erection, concrete placing and form stripping—without interference from adjacent pours. When the vertical construction joints were located, lift heights were determined to give the desired daily yardages. The maximum lift height was 16 ft.

Using a 6-ft liquid head of concrete and a form pressure of 1,200 lb per sq ft, 2-in. vertical timber sheeting with 3 × 10-in. studs on 23-in. centers was used. The studs were capable of spanning 4 ft between the wales, which were constructed of 6-in. channels back to back. For the wale ties, 1-in.-dia alloy steel Richmond Tyscrus were employed. For the panels on the curved section of the structure, double studs were used to provide continuity around the curve.

Concrete came to the job in truck-mounted mixers and was pumped to the forms. This method required the minimum crew for concrete placing.

A completely different job, but one fully as interesting, was the construction of the intake extending 240 ft out from the sloping bank. Assembled in a structural frame above water level, three 6.5-ft intake pipes and a 3.5-ft warming line were lowered about 50 ft into the water to rest on Drilled-In Caissons, which extended an additional 30 ft into solid rock. The site was enclosed in two parallel rows of MZ-32 steel sheetpiling 29 ft apart which served to protect the area and to form the tremie seal, which enclosed the pipes in position. This sheeting was connected across the outshore end. At the upstream corner, a fin constructed of MZ-32 steel sheeting extended upstream 60 ft, curving slightly inshore to train the water past the end of the cofferdam in smooth lines, thus reducing turbulence and erosion. After the fin was driven, the river bottom was armored with riprap which extended around the fin and the end of the cofferdam 50 ft toward the center of the river.

Access for the driving of the steel sheeting was provided by a trestle fully enclosing the work. The top of the steel sheeting was tied to the trestle. The interior of the cofferdam was excavated by clamshell buckets, after which pairs of 24-in.-dia Drilled-In Caissons were installed, starting from the outboard end and spaced 40 ft on centers towards the pump well. The method of installing these caissons was similar to that used for the pump-well caissons.

The next step was to cover the bottom of the excavation with broken stone, which was leveled with care. The top of the broken stone was at El. −18, about 48 ft below the top of the sheeting, and about 27 ft below mean water. The 6.5-ft-dia pipes were delivered to the work in 40-ft sections. These sections were set in frames supported from the steel sheeting and spanning the cofferdam. The reinforcing steel and tremie bulkhead forms were then fabricated and placed around the pipes.

Between sections a joint was made with half sleeves. The section of pipe first lowered had a bottom half sleeve on its inboard end, while the succeeding section carried the top half sleeve on the outboard end. The sections were lowered by hand-crabs and cables. When the sections reached their final elevation, hanging cables were attached to the frames and the lowering cables disconnected. Before the first section of pipe could be concreted, the following section was lowered into place and the joint between the pipes checked. To prevent uplift of the tubes during concreting, pipe struts were used to hold down the frames.

The tremie concrete used for this encasement had an average slump of 6 in. and was poured using Type II cement, which has slow-setting, low-heat and sulfate-resisting characteristics. Tremie concrete was placed like that for the pump well.

Stone & Webster were the designing engineers and general contractor, for whom David Hill was the project manager, and A. Smith was the project engineer. Western Foundation Co. executed the contract as a joint venture with Spencer, White & Prentis. Construction design was performed by the Drilled-In Caisson Corp.

(This article is based on the paper presented by Mr. Flay before the Chicago Meeting of the Construction Division.)

Universal Diagram Gives Critical Depth in Trapezoidal Channels

STEPONAS KOLUPAILA

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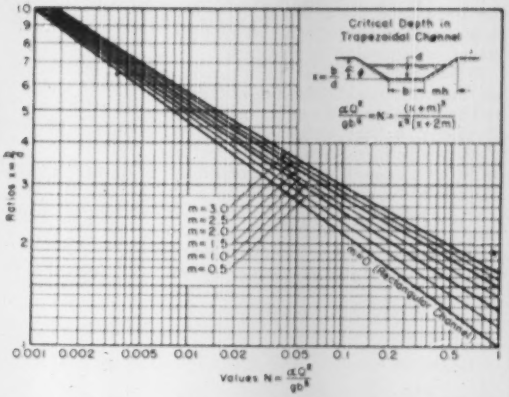


FIG. 1. DIMENSIONLESS DIAGRAM gives critical depth, d, which occurs when specific energy for given rate of flow, Q, is minimum.

CALCULATION of varied flow in open channels always involves as an important step the determination of the critical depth which occurs when the specific energy for a given rate of flow, Q, is minimum. The critical depth can be calculated from the equation,

$$gA^3 = \alpha Q^2 B \quad \ldots \quad (1)$$

in which g is the acceleration due to gravity; A, the area of the cross section; B, the surface width of that section; and α, the so-called Coriolis coefficient for the compensation for various velocities in the cross section. Both A and B may correspond to the critical depth.

This equation is easily solved for a rectangular channel, but the most common section in hydraulic engineering is the trapezoidal one. For this cross section,

$$A = (b + md)d \quad \ldots \quad (2)$$

$$B = b + 2md \quad \ldots \quad (3)$$

where b is the bottom width; d, the depth of water; and $m = \cot \phi$, the side slope of the channel. With these values, Eq. 1 becomes

$$g(b + md)^3 d^3 = \alpha Q^2 (b + 2md) \quad \ldots \quad (4)$$

When Q, b, and m are given, this equation must be solved for d, which will be the required critical depth.

The newest European textbook on hydraulics, by Charles Jaeger (*Technische Hydraulik*, Birkhaeuser, Basel, 1949), claims (p. 134) that d can be calculated from Eq. 4 without particular trouble. However, a direct solution of an equation of the sixth degree is quite impossible. Most authorities in hydraulics agree that the only suitable method is one of successive trials.

W. H. Overshiner (in his article, "Critical Depth in Trapezoidal Channels," CIVIL ENGINEERING, Feb. 1936, p. 112) introduced the ratio $y = d/b$ and calculated a table for finding y corresponding to M, that is,

$$M = \frac{Q^2}{b^5} = gy^3 \frac{(1 + my)^3}{(1 + 2my)} \quad \ldots \quad (5)$$

This table was inconvenient because it was prepared for inverse reading and suitable for English units only.

TABLE I. CALCULATED VALUES OF N FOR VARIOUS m AND x VALUES

m =	0	0.5	1.0	1.5	2.0	2.5	3.0
x = 1	1.000	1.688	2.67	3.91	5.40	7.15	9.14
x = 2	0.1250	0.1630	0.211	0.268	0.333	0.407	0.488
x = 3	0.0370	0.0441	0.0527	0.0625	0.0734	0.0856	0.0987
x = 5	0.00800	0.00887	0.00988	0.01098	0.01220	0.01350	0.01490
x = 10	0.001000	0.001053	0.001110	0.001170	0.001244	0.001302	0.001374

Various Graphical Solutions Reviewed

Many efforts have been made to solve this problem graphically. F. S. Bailey ("Finding the 'Critical Depth' in Hydraulic-Jump Calculations," *Engineering News-Record*, Nov. 20, 1925, pp. 810-811) proposed a diagram for critical depth in a rectangular channel as an aid for easier approximation to other cross-sections.

In 1929 the Russian engineer A. N. Rachmanov (see *Brief Consulting Book of Hydraulics*, N. N. Pavlovskij, Techgosizdat, Leningrad, 1940) introduced a peculiar ratio $\rho = b/m$ and constructed a complicated nomogram for direct reading of the critical depth for a given ρ and value of M_1:

$$M_1 = \frac{\alpha^{1/3} Q}{m} = \frac{g^{1/3} d^{4/3} (\rho + d)^{2/3}}{(\rho + 2d)^{1/3}} \quad \ldots \quad (6)$$

This nomogram was suitable for metric units only.

In 1948 Warren De Lapp ("Calculating Critical Depth in Trapezoidal Channels," *Engineering News-Record*, Dec. 23, 1948, p. 82) presented a nomogram for finding the critical depth corresponding to two peculiar ratios, $m:b$ and $Q:b$, both with un-

usual dimensions (ft^{-1} and square feet per second).

In a very interesting study, P. Z. Kirpich ("Dimensionless Constants for Hydraulic Elements in Open-Channel Cross-Sections," CIVIL ENGINEERING, Oct. 1948, pp. 649-651) suggested the application of *dimensionless* constants for open-channel solutions. He gave a diagram for estimating the critical depth, but for the foot-pound system only. It is not clear why Mr. Kirpich abandoned his presumed procedure in this case.

Following his suggestion, a universal diagram, actually dimensionless and suitable for all units, has been developed by the writer. This diagram can be easily constructed and is sufficiently exact for all practical purposes.

Constructing the Diagram

The writer prefers another ratio, $x = b/d$, which usually is more than 1. Substituting it in Eqs. 2 and 3 we obtain,

$$A = (x + m)d^2 \qquad (7)$$

$$B = (x + 2m)d \qquad (8)$$

and Eq. 1 becomes,

$$g(x + m)^3 d^6 = \alpha Q^2 (x + 2m)d \qquad (9)$$

A dimensionless expression, N, can be developed by regrouping the members:

$$N = \frac{\alpha Q^2}{g b^5} \qquad (10)$$

Hence, $$N = \frac{(x + m)^3}{x^5(x + 2m)} \qquad (11)$$

The necessary values of N can then be calculated, as given in Table I, simply by using Eq. 11.

By plotting N against x on logarithmic paper, a diagram (Fig. 1) can be constructed for various slopes, m.

To use the diagram, the value of N must be calculated first by Eq. 10. Then the corresponding value of x can be read from the diagram for this N and the given m. The critical depth is determined from $d = b/x$.

Example 1, in English units. Given: $Q = 200$ cfs, $b = 6$ ft, $m = 1.5$, $\alpha = 1.1$, $g = 32.2$ ft per sec^2.

$$N = \frac{1.1 \times 200^2}{32.2 \times 6^5} = 0.176$$

On Fig. 1, for $N = 0.176$ and $m = 1.5$, read $x = 2.25$.

Then $d = 6/2.25 = 2.67$ ft.

Example 2, in metric units. Given: $Q = 5.00$ cu m per sec, $b = 2.00$ m, $m = 1.5$, $\alpha = 1.1$, $g = 9.81$ m per sec^2.

$$N = \frac{1.1 \times 5^2}{9.81 \times 2^5} = 0.0876$$

On Fig. 1, for $N = 0.0876$ and $m = 1.5$, read $x = 2.72$.

Then $d = 2.00/2.72 = 0.735$ m.

Extra Flange Rivets for Web Splice Easily Computed

TEDDY LAPPO

Senior Civil Engineering Student, University of Detroit, Detroit, Mich.

WHEN the web splice of a girder is designed for the full strength of the web in bending, it is necessary to furnish plates in each flange to carry the moment of the web being spliced. The plates designed to carry this moment require additional rivets on the abutment side of the splice among the rivets required for shear (See *Structural Design in Steel*, T. C. Shedd). Placing these extra rivets and computing the length of plates required to encompass them is the problem here considered.

The following notation is used:

p = pitch required for horizontal or combined shear in the flange

p' = reduced pitch in the splice plate

m = number of additional rivets required

n = number of spaces of p which will have to be replaced by $(n + m)$ of p'

This notation varies from Shedd in that p is the computed pitch instead of the regular pitch.

The most obvious solution in equation form is:

$$np = \frac{m}{1/p' - 1/p} \qquad (1)$$

which is the length of reduced pitch in inches required to contain the additional rivets, m.

This is a development of Shedd's general equation,

$$np = (n + m)p'$$

Example 1. Single row of rivets (Fig. 1), where $m = 5$; $p = 8$ in.; and $p' = 3$ in. (minimum allowable pitch). By Eq. 1,

$$np = \frac{5}{1/3 - 1/8} = \frac{5}{0.208} = 24 \text{ in.},$$

length of plates required to encompass the additional rivets.

The equation can be visualized as using an available part of an extra rivet in each lineal inch of flange. Prudence requires the pattern to be extended to the first multiple of the pitch p'. In this case 24 in. is satisfactory.

The length of the plate beyond this length is controlled by specifications.

Example 2. Three rows of rivets (Fig. 2), where

$m = 12$; $p = 6.4$ in.; and minimum rivet spacing = 3 in.

$$p' = \frac{3 \text{ in.}}{3 \text{ rivets}} = 1 \text{ in. (every 3 in. contains 3 full rivets).}$$

By Eq. 1,

$$np = \frac{12}{1/3 - 1/6.4} = \frac{12}{0.844} = 14.22 \text{ in.}$$

Use 15 in. Thus 15 in. is the first multiple of $1\frac{1}{2}$ in. beyond the computed length, and $1\frac{1}{2}$ in. is the horizontal distance between the rivets.

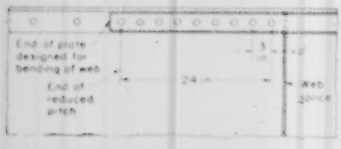


FIG. 1. IN EXAMPLE 1, for single row of rivets, length of reduced pitch equals 24 in.

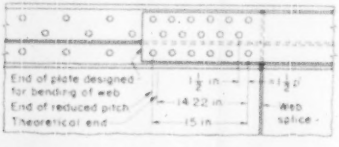


FIG. 2. IN EXAMPLE 2, for three rows of rivets, length of reduced pitch equals 15 in.

SOCIETY NEWS

Merry Christmas and a Successful New Year

Hydraulics Division Meets with Mid-South Section

WITH AN ENTHUSIASTIC attendance of more than 400 engineers from all over the United States and Canada, the first meeting of the Hydraulics Division of ASCE separate from a general Society meeting was successful beyond all expectation. Held at Jackson, Miss., November 1 to 3, in conjunction with the 21st annual meeting of the Mid-South Section, the joint program reflected careful advance planning of Mid-South Section committees headed by the Jackson Branch President Sydney W. Chandler as chairman and Joseph B. Tiffany, of the Waterways Experiment Station, as vice-chairman.

Technical Sessions Have Wide Scope

Two full days were given over to technical papers on the general theme of the meeting, "What's New in Hydraulics." In recognition of the fact that many hydraulic data collected in various places throughout the country are not generally available to engineers, the opening papers were presented by representatives of two agencies that are taking steps to make such data readily available—Merrill Bernard, chief of the Climatological and Hydrological Services of the U. S. Weather Bureau, and J. V. B. Wells, chief of the Surface Water Division of the U. S. Geological Survey.

One of the highlights of the program was the presentation of material having to do with electric analogs, which are becoming a highly necessary tool for the civil and hydraulic engineer. Max A. Kohler, chief of the Procedure Development Station of the Weather Bureau, described the new electronic stream-flow routing analog developed by the Bureau for use in stream-flow forecasting, in the first paper in the field. A whole morning was given over to subsequent treatment of the subject, with the presentation of five papers on analog computers and experiments to study hydro-dynamic problems in civil engineering.

The many other papers on the agenda included a presentation by S. W. Jens, of Horner & Shifrin, St. Louis, of a study by the Committee on Hydrology of the role of hydrology in engineering.

Waterways Experiment Station Visited

Rain failed to cut down attendance for the inspection trip to the Mississippi Basin Outdoor Model and the many hydraulic models at the U. S. Waterways Experiment Station at Vicksburg. Constructed to a horizontal scale of 1:2,000 and vertical scale of 1:100, the Mississippi Basin model facilitates study of such problems as levee grades and alignments, effect of reservoir operation on floods, flood routing, and other phenomena involving channel capacities and storage. Demonstrations were given of the extensive automatic instruments that control and record the flow in the model.

Varied Social Program

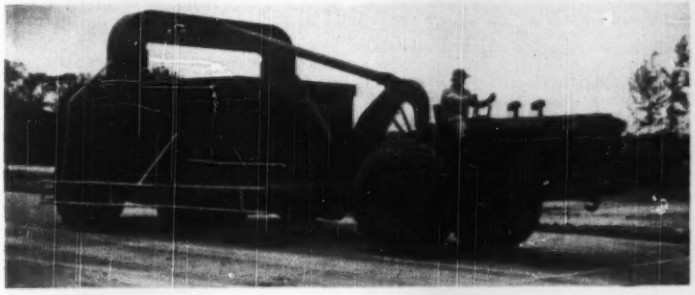
At the Hydraulics Division Banquet on November 1, Toastmaster M. P. O'Brien introduced ASCE President Ernest E. Howard and President-Elect Gail A. Hathaway. ASCE Honorary Member Boris A. Bakhmeteff discussed "Hydraulic Engineering Memories" going back over a distinguished career of fifty years and urged the profession to take a more active interest in community affairs. In closing he stressed the challenging problems that still lie ahead and the need for engineers to be trained to solve these problems.

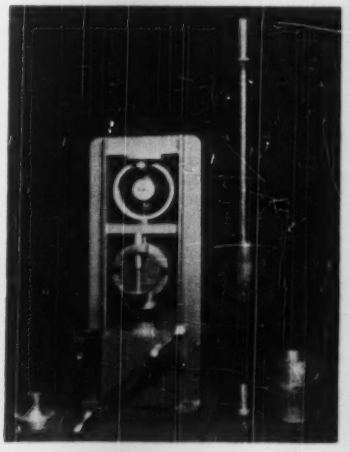
Mid-South Section Elects New Officers

During the Mid-South Section's annual business meeting, the following officers were elected: W. J. Turnbull, Vicksburg, president; S. W. Chandler, Jackson, vice-president; and H. G. Dewey, Jr., Jackson, secretary-treasurer. Directors for two-year terms will be E. B. Madden, Little Rock, and C. O. Wagner, Memphis.

Student Activities

To encourage a large student attendance, the Section and the Hydraulics Division secured special hotel rates for Student Chapter members, and made tickets for all functions available to them at half price. Chapters at Louisiana State Uni-





LOAD TEST CART (lower photo) for applying airplane tire pressure to flexible pavements is part of equipment at Waterways Experiment Station viewed by ASCE Hydraulics Division members. Cart has maximum capacity of 200,000 lb, and unit is pulled by standard Super-C Tournapull Tractor. Tires, inflated to 270 psi, are mounted inside load test box. View at right shows Marshall Testing Machine to determine flow and stability of hot-mix asphaltic concrete for landing fields. Samples are compacted in mold at right, using hammer next to it.

versity, the University of Mississippi, and Mississippi State College were represented by 34 members.

GET-TOGETHER AT RECENT JOINT MEETING of ASCE Hydraulics Division and Mid-South Section in Jackson shows (seated, left to right) Executive Secretary William N. Carey, President Ernest E. Howard, President-Elect Gail A. Hathaway, and A. S. Fry, chairman of ASCE Hydraulics Division. Standing are H. S. Gladfelter, president of Mid-South Section, and N. R. Moore, ASCE Director-Elect from District 14.

EJC Nominees Appointed to National Science Board

DONALD H. MCLAUGHLIN, Edward L. Moreland, M. ASCE, and Andrey A. Potter have been named by President Truman as members of the new 24-man Board of National Science Foundation. These three engineers were among the nominees presented to President Truman by Engineers Joint Council. With the EJC list of nominees went a strong recommendation that applied science, as represented by engineers, be given appropriate consideration on the Board of National Science Foundation.

Mr. McLaughlin is president of the Homestake Mining Co., Mr. Moreland a principal in the Boston consulting engineering firm of Jackson and Moreland, and Mr. Potter dean of engineering at Purdue University. The other members of the Board, as named by President Truman, all subject to confirmation by the Senate, are Detlev W. Bronk, James B. Conant, John W. Davis, Charles Dollard, Lee A. Dubridge, Edwin B. Fred, Frederick A. Middlebush and George D. Humphrey, all university presidents; Percy Barnes, Gerti T. Cori, Paul M. Gross, O. W. Hyman, Robert F. Loeb, Joseph C. Morris, Harold M. Morse and Henry Yancey, all deans or professors of university science departments; Sophie D. Aberle, James A. Reyniers, Elvin C. Stakman, science laboratory chiefs; Charles E. Wilson, president, General Electric Co.; and Chester I. Barnard, president, Rockefeller Foundation.

Presentation of testimony before Congress, which resulted in specific inclusion of engineering in the legislation creating the National Science Foundation engineering was not mentioned in the first bills) and presentation of argument that resulted in the appointment of three engineers on the Board were major achievements of EJC. In this effort EJC was assisted throughout by the American Society for Engineering Education.

November Meeting of Engineers Joint Council Summarized

PRINCIPAL ACTIONS TAKEN by Engineers Joint Council at its November 17 meeting, in New York, are briefed here.

Increased Professional Unity

H. S. Osborne, AIEE, chairman of the Committee on Unity, reported conclusions of a joint conference with officers of Engineers Council for Professional Development, convened September 21, to explore the possibilities of closer relationships between ECPD and EJC. To extend the cooperation already stimulated by an exchange of minutes of the two organizations, EJC invited a representative of ECPD, preferably its chairman, to attend all EJC meetings as an accredited representative.

Chairmanship of U. S. Delegation to International Engineering Conference

EJC took cognizance of the forthcoming international engineering conferences to be held in Bombay and New Delhi, India, during January 1951, and by resolution urged the Secretary of State to designate a technically qualified engineer to head the United States delegation. It recommended the appointment of Gail A. Hathaway, President-elect of ASCE, to this important post.

Engineering Manpower Commission

Three important factors now face the working committee of the Engineering Manpower Commission (CIVIL ENGINEERING, November 1950, page 51) in arriving at (1) an answer to National Security Resources Board, and (2) a modification of administrative procedures relating to the current Selective Service Act. They are the impending acute shortage of engineers, the popular support that Universal Military Training is receiving, and the expanded reserve-training program covered in pending legislation. These factors will drastically reduce the meager supply of engineering skills available to satisfy non-military needs. The EJC Manpower Commission reported that as an immediate objective, it expected to submit its legislation recommendations to the NSRB in December.

Engineers Appointed to National Science Foundation

B. A. Bakhmeteff, Hon. M. ASCE, chairman of the Science Legislation Panel reported that President Truman had included three of the engineers recommended by EJC among his recent appointments to the 24-man National Science Foundation Board. The appointees are named elsewhere in these pages. EJC noted with gratification this recognition of engineers on the research board.

New Officers

The 1951 officers of EJC are J. M. Todd, Past-President, ASME, president; James F. Fairman, Past-President, AIEE, vice-president; C. E. Davies, Secretary ASME, secretary; and E. Lawrence Chandler, Assistant Secretary, ASCE, treasurer.

Sections Asked to Give Aid in Civilian Defense Work

AT THE REQUEST of the Executive Committee of the Board of Direction at its Chicago Meeting, the Executive Secretary has written to the secretaries of all Local Sections and Sub-Sections or Branches on the subject of civil defense. The letter conveys the recommendation of the committee that the local ASCE groups offer to local civil defense officials their advisory services for the development and execution of civil defense programs.

AERIAL VIEW OF DOWNTOWN HOUSTON (above) gives idea of the city's unprecedented postwar expansion that has made it the industrial center of the South. Gulf Freeway (right) under construction will connect Houston with Galveston when completed in 1951. Finished section of 4½ miles, shown here, cost almost $10,000,000.

Houston Prepares for Outstanding ASCE Convention

ENGINEERS AND THEIR families going to Houston, Tex., for the ASCE Winter Convention, February 21–24, are assured an exceptional program of technical papers (with all but one or two of the Society's thirteen Technical Divisions planning sessions), excursions, and entertainment. The unusually rapid expansion of Houston as an industrial and commercial center provides a stimulating background for an engineering convention, and opportunity to study at first hand a variety of outstanding accomplishments. Unusual engineering structures, an extensive freeway system, railroad, seaport, and airport projects, new sanitary facilities—all will be on display for the visitors to Texas' biggest city. Oil fields a few miles from the center of the city will be of interest to those who have not had a chance to see oil being produced.

Varied Entertainment Planned

Throughout the Convention week, numerous unusual entertainments will be offered, including a barbecue at the Rice Stadium. The stadium is not only well adapted to holding a barbecue, but will also be the objective of an inspection tour for the visiting engineers. Other planned entertainment includes the traditional dinner dance and a buffet dinner at the exciting new Shamrock Hotel.

A program of entertainment for the women visitors is being arranged by the ladies of the Texas Section under the chairmanship of Mrs. R. J. Cummins. Sightseeing expeditions will tour downtown Houston, and there will be special opportunities for shopping in the city's outstanding specialty shops. A style show will be held at the Shamrock Hotel, and a special tour of camellia gardens is being arranged, to be followed by tea at the River Oaks Country Club.

The ladies are urged to bring comfortable walking shoes, so they can fully enjoy the sightseeing and shopping tours. Light but warm sport clothing will probably be needed, despite the fact that February temperatures in Houston are unusually mild, averaging from 50 to 60 deg.

Excursion Possibilities

Members wishing to have a winter vacation in Mexico City after the Convention are reminded that it is only four hours distant by plane from Houston. Reasonable rates for a Mexico City excursion will be available. Points of interest nearer the city include the San Jacinto Battlefield, which may be visited by a boat excursion down the Houston Ship Channel. Galveston, Tex., at the mouth of the Gulf of Mexico, is only an hour and a half from Houston by bus or train.

Local Section and Student Conferences

Students from a wide area will be invited to attend a conference of Student Chapters during Convention week, to which the Rice Institute Student Chapter of ASCE will be host. Other Texas Chapters are participating in plans for an unusual program, which will include excursions.

A Local Section Conference, sponsored by the Board of Direction for the purpose of expanding and improving ASCE activities at Section level, is being arranged for delegates from a number of Sections in the area for the first two days of the Convention week.

Full Program in January Issue

Details of all Houston Convention events will be given in the full program, to be printed in the January issue. Robert J. Cummins is general Convention chairman, with Mason G. Lockwood serving as chairman of the technical program. Headquarters for the Convention will be the Rice Hotel in downtown Houston, convenient to all transportation facilities.

Slump in Engineer Enrollments in College Reported

THERE HAS BEEN a decided drop in enrollment in the engineering schools of the nation, according to a nation-wide survey sponsored by the American Society for Engineering Education. S. C. Hollister, dean of the College of Engineering at Cornell University and chairman of the Survey Committee, said that, at its peak in 1948, engineering school enrollment was 226,000, and in 1949, it had dropped to 181,000. While the 1950 enrollment of 130,000 is greater than the 1940 figure of 108,000, enrollment in 1951 will probably be no larger than the

1940 enrollment, and a year later it can drop below 90,000. This drop in enrollment threatens a serious shortage of engineers. Last year every one of the 50,000 graduates was absorbed in professional activities.

The study indicates that, under normal peacetime conditions and if Selective Service permits engineering students to complete their courses, the engineering schools can be expected to graduate 32,500 in 1951; 21,900 in 1952; 17,000 in 1953; and 12,400 in 1954.

Under civilian peacetime conditions, the profession will absorb 20,000 engineering graduates every year. Industrial and military needs, added to normal peacetime demands, will require a minimum of 30,000 graduates. This indicates a need for 10,000 to 20,000 more engineering graduates annually. To graduate 30,000 a year means that no fewer than 60,000 freshmen enter engineering schools each year. In 1950 only 26,500 freshmen enrolled in engineering courses.

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Engineer Shortages and Training Program Hold Spotlight at ECPD Annual Meeting

MILITARY PREPAREDNESS WILL have an immediate, sharp and devasting effect on higher education in America if present proposals are carried through, Raymond Walters, president of the University of Cincinnati, warned in a leading speech given at the 18th annual meeting of the Engineers' Council for Professional Development, held in Cleveland, Ohio, October 20-23.

"The President's call for 3,000,000 men by the fall of 1951," he warned, "may prove to be as serious to higher education as total mobilization in World War II, since the draft is to be of the younger men 19 to 26 years of age. Population within these younger age groups is diminished, because of the low birth rate during the 1930's and by the exemption of veterans and men with dependents."

To increase the seriousness of the situation, President Walters said, industry is making unusually heavy demands on the supply of engineering graduates. It has already absorbed the entire crop of 50,000 June engineering graduates, which represented an all time graduation peak in the field. Citing a recent survey of over 500 approved colleges and schools, he stated that 75 percent show sizable decreases in full time student enrollment compared with a year ago. Engineering colleges show heavier losses than other types of colleges, both in the number of full time students and in freshman entrants. Part of this decrease he attributed to a Department of Labor report indicating the engineering field to be overcrowded.

The situation, President Walters emphasized, is of serious concern to the entire nation. "The mass production of America and its consequent high standard of living depend on the training in engineering institutions of a large number of high grade engineers," he concluded.

On the same program, Harry S. Rogers, M. ASCE, chairman of ECPD and president of the Polytechnic Institute of Brooklyn, gave the high points of the ECPD annual report. He recommended that "we define our [ECPD] undertakings more clearly and specifically; that the programs of our committees have sharper focus and continuity; and that we organize internally and cooperatively to produce more tangible and constructive achievements."

Professional Training Program

Better engineers, fitted for the increasing tempo of technical progress and developed through more efficient use of the first five years following graduation, is the objective of the ECPD Committee on Professional Training, which presented a six-point program during the meeting. As outlined by committee chairman A. C. Monteith and subcommittee chairmen, the program covers the orientation and training of engineering personnel by employers; cooperation in industrial and engineering schools for the continued education of the graduate engineer; guidance in integrating the young engineer with his community; legal registration as a means but not an end to professional development; and use of self appraisal aids among young engineers. The committee's researches, covering 15 years, are recorded in a voluminous report, "The First Five Years of Professional Development."

"Career counseling given wisely and early," was advocated by A. R. Hellwarth, of the Detroit Edison Co., as a means of reducing the number of men who fail to measure up during the training period. It will help "industry save time and money, and bring happiness rather than disappointment to the potential employee," he claimed. Mr. Hellwarth remarked that, "Industry invests at least $10,000 and two years of irreplaceable time before a newly recruited engineer is able to accept the full responsibility of a job in modern industrial organization."

ECPD Officers for 1951

ECPD officers for the coming year, elected during the meeting, are Harry S. Rogers, chairman; L. F. Grant, vice-chairman; William N. Carey, secretary; and Edward H. Robie, assistant secretary. ASCE representatives are Van Tuyl Boughton, Dr. Rogers, and Frank C. Tolles.

SHOWN AT ECPD annual dinner are, left to right, Dr. Walters, Colonel Grant, ECPD Chairman Rogers, and ASCE President Ernest E. Howard.

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Dues Increase Is Voted by Mechanical Engineers

THE AMERICAN SOCIETY of Mechanical Engineers has passed a constitutional amendment providing for a dues increase of $5 a year in a ballot canvassed on November 8. To go into effect on October 1, 1951, the increase will raise the dues of Members, Fellows, and Affiliates from $20 to $25. Only Juniors under 30 will be unaffected by the change. They will continue to pay $10 a year. The annual rate for Juniors between the ages of 30 and 33 will be increased from $15 to $20, and Juniors over 33 will pay $25 a year instead of $20.

With a two-thirds vote required for passage of the constitutional amendment, 67.7 percent of the votes cast were in favor of the dues increase.

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Engineering Curricula Are Accredited by ECPD

TO ITS LIST of Accredited Undergraduate Engineering Curricula, the Engineers Council for Professional Development added five new courses at its recent annual meeting in Cleveland. These are Civil Engineering at the University of Akron; Engineering at the University of California at Los Angeles; Civil Engineering at the University of Denver; Sanitary Engineering Option at the University of Missouri; and Civil Engineering at the University of Toledo.

Appointments Made to ASCE Technical Division Executive Committees

THREE OTHER MEMBERS of ASCE recently appointed to Technical Divisions are: Charles Blessing, of the City Planning Division, I. C. Steele, of the Power Division, and R. H. Lyddan, of the Surveying and Mapping Division.

Ralph H. Burke
Air Transport

Harry O. Wright, Jr.
Air Transport

Leslie Williams
City Planning

C. D. Riddle
Construction

C. H. Mottier
Eng. Economics

Roy E. Jorgensen
Highway

G. H. Hickox
Hydraulics

A. P. Rollins
Irrigation

C. C. Boswell
Power

H. B. Gotaas
Sanitary Engineering

B. A. Poole
Sanitary Engineering

Rolf Eliassen
Sanitary Engineering

Arthur Casagrande
Soil Mechanics & Foundations

George E. Brandow
Structural

Carl B. Jansen
Waterways

Applications for Freeman Fellowship Are Invited

A JOINT PROGRAM for award of the Freeman Fellowship has been adopted by ASCE and the ASME, which will follow a common policy of handling the applications and making the awards in alternate years. Both will give publicity to the award each year. In 1951 the award will be made by ASCE. Applications, to be submitted prior to February 1, 1951, are invited subject to the following conditions:

1. The applicant must have completed three years of work or study in the field of hydrology or hydraulic engineering subsequent to receiving the bachelor's degree.

2. The applicant shall submit a program of study or research, covering a period of at least nine months starting sometime during the year 1951.

3. The applicant shall submit a statement of the funds necessary under the fellowship in order to carry out the proposed program.

4. In making the award, preference will be given to the applicant who is a member of one of the two cooperating societies.

The Freeman Fund may be used for grants-in-aid of research, for aid in publishing meritorious works related to hydraulic engineering, for translations, and for prizes and fellowships. The committees in charge for the two societies have agreed to use the funds for the present in support of advanced study or research. For the coming year, the amount of $2,500 is available.

Applications should be submitted to the Society's Freeman Fund Committee in care of the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N.Y. The award is expected to be made by March 15.

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative, ASCE

Military Construction Up

EARLY IN NOVEMBER the first detailed listing of military construction projects of the Corps of Engineers during the current fiscal year was announced. About two-thirds of this $209 million program is outside of the United States, principally in Alaska and Okinawa.

This is but the first of a large military program. About December 1 the Defense Department and the Budget Bureau will work out a proposal for future expenditures. Requests will be made for appropriations in the remaining weeks of the 81st Congress and again in the early days of the 82nd Congress. It is expected that at least $10 billion will be requested.

The District Engineer offices are the primary centers for employing engineering and contracting services for Army and airport work. A brochure, describing a firm's past work and experience of its key employees and emphasizing work of the kind likely to arise in the military program, should be submitted to the District office. Copies may also be filed with the Division office and also with the Assistant Chief of Engineers for Military Construction in Washington.

We seem to be heading for a $40 billion a year defense budget, compared with under $15 billion before the Korean issue arose. The Treasury is now paying out about $1.4 billion a month for military expenditures. During the next fiscal year, that amount may go to $2 billion a month and in the fiscal year following that to $3 billion or more per month.

A satisfactory settlement of the Korean war means only that there will be less haste in stockpiling fighting equipment and a more orderly diversion of materials to the expansion of productive facilities.

NPA Clamping Down

Increased military expenditures can be expected to develop serious shortages of some materials. The National Production Authority (NPA) is dealing with the present and prospective situation by the issuance of various restrictive orders. Regulation M-4 prohibited construction of certain recreational and amusement facilities. This was a limitation or prohibition order relating to an end product, in this case construction.

When the order was first issued, it contained an objectionable clause to the effect that any construction job might be halted while in progress. A Committee on Construction Mobilization, sponsored by the U. S. Chamber of Commerce and composed of leaders in the construction industry, discussed the objectionable features of this clause with Administrator Harrison several days after the order was issued. He agreed on the desirability of striking out the objectionable section and issued an amending order shortly thereafter. Former ASCE Vice-President Carlton S. Proctor, vice-chairman of the committee, represented the Society. Administrator Harrison has indicated that he is not generally in favor of prohibition orders. Business and industry are opposed to them, conservation orders being more acceptable.

Typical of conservation orders is NPA Regulation M-7—issued in November to become effective January 1—ordering a cutback of 35 percent in the use of aluminum for non-defense purposes. This still leaves considerable discretion to manufacturers as to what they may make and how much of various materials they will use per unit. It gives more room for private initiative than do prohibition orders. The issuance of conservation orders indicates, however, that voluntary controls by industry itself are not being counted on in the case of critical materials. Other conservation orders are expected to follow for copper, various alloying materials for steel, and probably for steel itself.

The organization for handling controls is gradually taking shape. In the NPA three divisions of interest to engineers have been established—Construction Materials (except steel and lumber) under John Haynes; Construction Controls under James Follin; and a Facilities Division under Frank Creedon, devoted to reviewing applications for government loans or for accelerated amortization for new production facilities. Steel and lumber are handled by separate divisions.

A Defense Transportation Administration (DTA) has been established under James K. Knudson, as Administrator. It will be a claimant agency on NPA for materials necessary to keep up our transportation system. The Interior Department, charged with responsibility for pipe lines, electric power, fuels and minerals is assigning a staff to handle these matters.

NPA recently delegated to the Defense Department authority to issue orders for procurement and for construction for the Department, the Mutual Defense Assistance Program, the Bureau of Standards, and other agencies as may be designated by NPA. The Coast Guard and National Advisory Committee for Aeronautics have direct priority powers also. The Atomic Energy Commission has very broad powers.

The appointment of three members of the newly created National Science Foundation (see names elsewhere in this issue) from the list of nominees submitted by Engineers Joint Council marks the culmination of an extended campaign to place engineering in this important development. One of the first duties of the Board is to nominate a director to head the staff operations. Appointment will be by the President from nominations by the 24-man Board. The Board will also select its own chairman and vice-chairman.

Point IV Needs Engineer Direction

The Field Representative recently attended a meeting of private organizations called by the State Department to discuss the Point IV Program of technical assistance to underdeveloped countries. The various undertakings urged by the participants lead to the feeling that this program might degenerate into a world WPA. Some present believed that the limited funds available may be dissipated unless they are directed toward tangible physical objectives, such as improvement in facilities or production of materials and goods, the development of transportation and similar items having a rather definite relation to engineering. Technical and business representatives present felt that broad-gage engineers should play a leading part in the overall direction of the program.

ASCE Participation

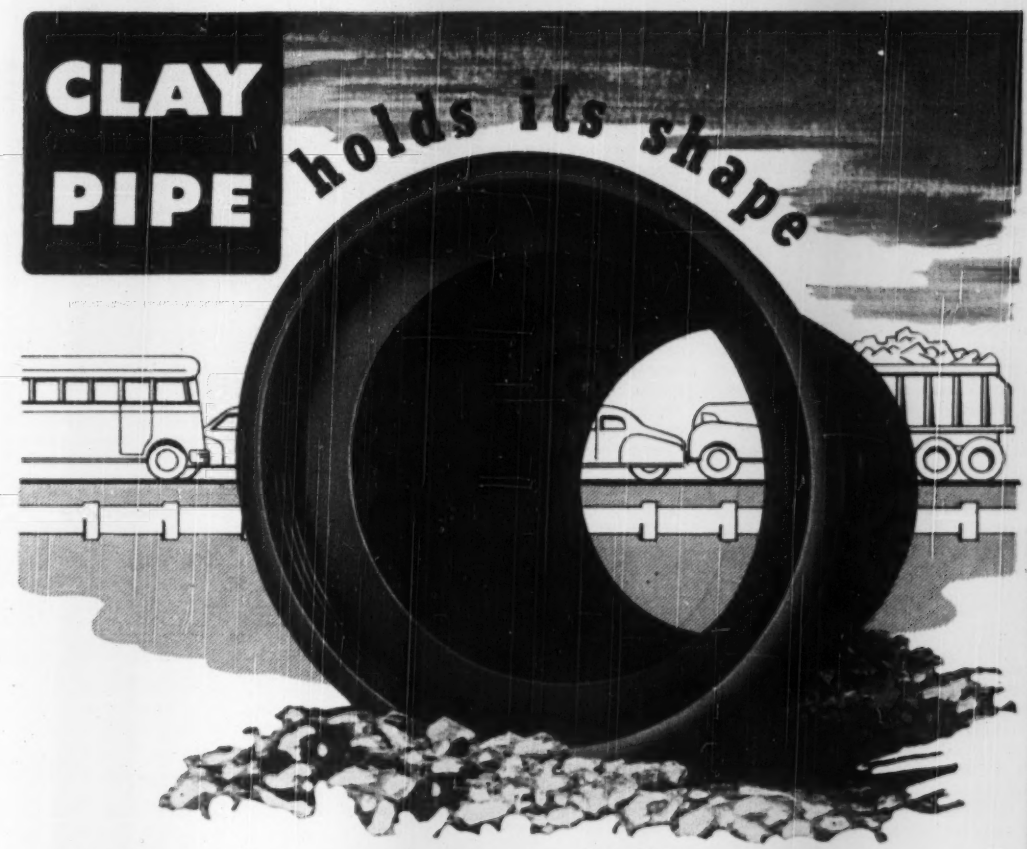
Top ASCE officials recently conferred with heads of the engineering branches of the Army, Navy, and Air Force.

ASCE has participated actively in the organization and operation of the Building Research Advisory Board. "Fire Resistance of Exterior Non-Load-Bearing Walls" was the subject of a recent BRAB conference, attended by a number of ASCE members. Results of research in this field were discussed and many innovations in design and construction proposed. Present criteria and building codes were critically reviewed. Proceedings of the conference will be available soon as a separate volume.

At a conference on urban problems the question of city development as related to national security was discussed. Of particular interest was the discussion of plans for the decentralization of Washington as a general city planning problem and of a more drastic plan of decentralization as a precaution against atomic attack. ASCE members presented papers.

Washington, D.C.
November 24, 1950

CLAY PIPE holds its shape



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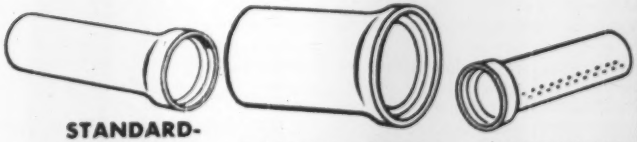

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C-4184

Centennial of Engineering Has Far-Reaching Objectives

THE CENTENNIAL OF Engineering is seen as "a new and united force needed to bring to the public the story of the engineering profession and to show what the profession has contributed to our standard of living." A release from the Centennial of Engineering, 1952, Inc. sets forth further objectives of the ASCE centennial celebration, to be held in Chicago in September 1952.

Centennial of Engineering, 1952, Inc., has been organized to help the engineering profession tell its story to the public. It must not be a technical story, full of calculus and abstract truss design problems; it must be a human interest story, which deals in terms of what the engineer has accomplished. The discussion of how it has been accomplished will be set forth in engineering terms for engineers in the Centennial Convocation, but the public exposition must tell the story in terms that the public will understand and appreciate.

The Centennial proposes to do this in two ways, each of which will present a different facet of the human-interest side of engineering. The first of these ways will be a dramatic show which will be presented in the main auditorium of the Chicago Museum of Science and Industry. The second will be a permanent exhibit in the museum, to be opened in July 1952 and to continue for at least five years thereafter.

In pageant form, the show will review the growth of the nation over its entire history but with particular emphasis on the last hundred years. It will show the development of industry and transportation and how these developments affected the development of every phase of national life. Interwoven into the story, just as it is interwoven into our daily lives, will be the influence of the engineers who planned and built the physical structure of our society. In this way the pageant will tell the human-interest story of what engineering has done for the people to ease their lives.

An exhibit—the second feature of the exposition—will be planned to take the public behind the scenes in modern industry and construction, and show the people what an engineer is, and how he accomplishes his work. In this exhibit there will be cross sections showing the intricate phases of construction that assure safety and reduce costs. The exhibit will also contain a display showing how a need for a new product is handled, and how a seemingly simple request is filled by the aid of hundreds of engineers with almost as many specialties. Here, too, an attempt will be made to impress upon the public the complexity of even such an everyday thing as an automobile, which the people of the country have taken for granted for over twenty years.

The Centennial of Engineering can and will supply the unifying force needed to bring the engineering profession before the public mind in a way that is accurate and memorable. There is a great story to tell, and now at last it will be told.

President Howard Visits 75 ASCE Groups

EXTENSIVE TRAVEL HAS been on the agenda of President Ernest E. Howard during his term of office. Statistically he has visited 44 different cities in 24 states, some of them several times. Meetings with Local Sections, Student Chapters, Society committees, the ASCE Board of Direction, Engineers Joint Council, and the Engineers Council for Professional Development add up to a total of 75 different get-togethers with groups of ASCE members. These trips by train, plane, automobile, and bus total nearly 59,000 miles, which probably establishes a record for Presidential travel on behalf of the Society. The surprising total does not include a personal trip he will make to Honolulu in December accompanied by Vice President Sherman. The two officers expect to talk over ASCE affairs with officers and members of the Hawaii Section.

What message does the President have for the members? He is convinced that "desirable services of the Society to its members have been unfortunately restricted by lack of funds." He believes that additional services should include larger appropriation for publications, for public relations, and for direct service to members. Pointing out that the Board must balance the budget, he is frank to say that "additional funds should be provided by an increase in dues."

In his many sessions with officers and members of Local Sections he finds that while many members are thoroughly informed of ASCE affairs, others do not have a clear understanding of Society problems even though the Society attempts to keep them informed through CIVIL ENGINEERING. Especially do members appreciate personal contacts with their Directors reporting on Society activities. President Howard also finds considerable interest shown in EJC and ECPD, and in the coming Centennial of Engineering scheduled for 1952.

PROF. A. T. GRANGER, head of civil engineering department at University of Tennessee, is congratulated by ASCE President Ernest E. Howard upon his election as president of Tennessee Valley Section at recent fall meeting of Section in Chattanooga, while retiring Section President Raymond L. Forshay looks on. President Howard addressed annual banquet on "The Society and the Profession." Among other features of highly successful two-day program were trip through Du Pont nylon plant in Chattanooga and symposium on Hales Bar Dam and plant, led by TVA engineers Berlen C. Moneymaker, Adolph A. Meyer, and Alfred H. Weber. Attendance of over 100 engineers included ASCE officers Henry J. Sherman, of Camden, N. J., Vice-President for Zone II; William R. Glidden, of Richmond, Va., Vice-President-Elect for same Zone; and Executive Secretary W. N. Carey, of New York.

Utah Engineers Form Cooperative Council

ESTABLISHMENT OF THE Utah Engineering Council as a medium for cooperative action of the entire engineering profession in the state is announced by committees representing the member groups—local sections of ASCE, the AIEE, the American Society of Heating and Ventilating Engineers, the Utah Society of Professional Engineers, and the Intermountain Institute of Consulting Engineers. An outgrowth of a temporary Utah Engineers' Joint Committee set up in December 1948, the present organization states that its principal aims are "to promote the public welfare and provide means for more effective public services; to work for advancement of engineering education; and to work for the advancement of the engineering and associated scientific professions."

The UEC operates jointly with technical member societies by forming a common meeting ground for the entire engineering profession in the area. Its first semiannual membership meeting took the form of a joint session with the Intermountain Section of ASCE in Salt Lake City on October 25. The program consisted of a talk by L. E. Johnston, manager of the Atomic Energy Commission's Idaho Operations, who summarized the highlights of the past year at the AEC Reactor Testing Station near Arco.

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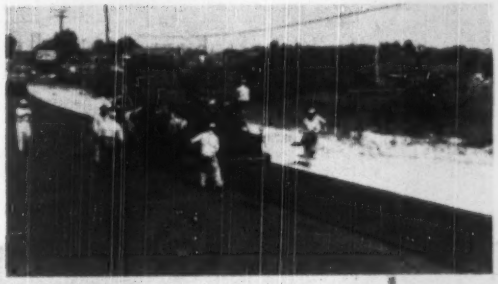

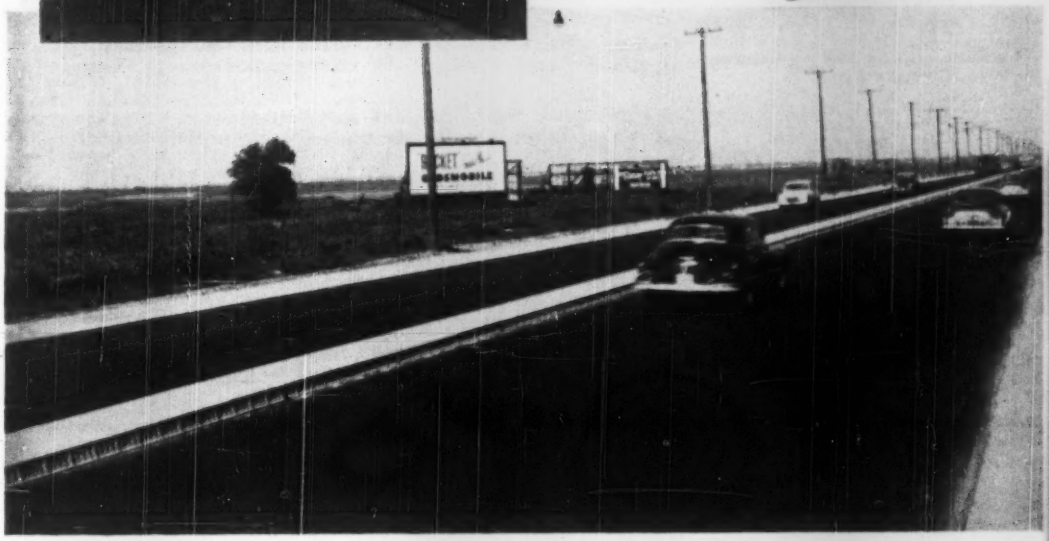

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Heavy-duty Asphaltic Concrete paving, thanks to its flexible, resilient qualities, has the ability to absorb and survive years of the most punishing traffic impact. To this exceptional durability, add a low upkeep cost, which makes Hot-mixed Asphaltic Concrete an economical pavement for important highways, principal streets and major airports.

Asphaltic Concrete paving is popular with motorists because its resilient, joint-free surface possesses a smooth-riding quality that lasts. Equally important to the motorist is the highly skid-resistant quality of Asphaltic Concrete, which contributes materially to his safety on the highway.

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For complete information on Asphaltic Concrete and other types of asphalt construction, write our nearest office for copy of the booklet, "Texaco Asphalt Paving—Plant-mixed Types."

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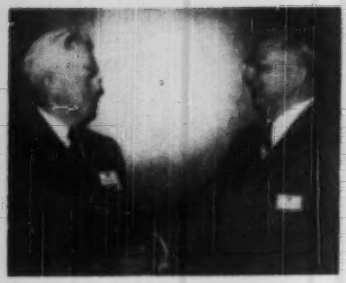


INVITATION TO ASCE SUMMER CONVENTION in Louisville, June 13-15, is extended to Society President Ernest E. Howard at Chicago Meeting by J. Frank Grimes, president of Kentucky Section.

Coming Local Section Events

Cincinnati—Meeting in Cincinnati the first Wednesday of each month.

Cleveland—Dinner meeting at the Cleveland Engineering Society, December 15, at 6:30 p.m.

Colorado—Dinner meeting at the Democratic Club, Denver, the first Monday of each month.

Florida—Annual meeting at the Seminole Hotel, Jacksonville, December 11, at 7 p.m.

Illinois—Weekly luncheons every Friday at the Chicago Engineers Club, at 12 noon.

Intermountain—Meeting in Salt Lake City on December 15.

Kansas—Meeting in Topeka, December 15, at 6:30 p.m.

Los Angeles—Annual meeting at the Alexandria Hotel, Los Angeles, December 13, at 6:30 p.m., with Junior Forum participating.

Maine—Newly formed Maine Section will hold its first technical meeting in Orono on December 15 and 16. It will constitute the first Annual Maine Highway Conference.

Maryland—Meeting at the Engineers Club of Baltimore, Baltimore, December 13, at 8 p.m.; preceded by cocktails at 6:15 p.m. and dinner at 7 p.m.

Metropolitan—Meeting of Junior Branch in the Engineering Societies Building, New York City, December 13.

Miami—Meeting in Miami the first Thursday of each month.

North Carolina—Annual meeting at Duke University, Durham, on January 13.

Oklahoma—Dinner meeting of the Oklahoma City Branch in the Y.W.C.A. Building, Oklahoma City, December 15, at 7:30 p.m. Meeting of the Tulsa Branch in the Chamber of Commerce Building, Tulsa, the first Monday of each month.

Philadelphia—Meeting in Philadelphia on December 12.

Seattle—Dinner meeting at the Engineers Club, Seattle, December 27, at 6:15 p.m.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	October 12	14	"Akron's Highway Program" was discussed by Nathan Koplin.
Buffalo	October 17	45	Luncheon meeting with Edwin S. Cullings, consulting engineer and chief engineer, Black River Regulating District, Watertown, N.Y., speaking on the problem of water conservation.
Cincinnati	October 4	40	A. C. Neff, vice-president, Armco Drainage & Metal Products, Inc., and vice-president of Ohio Highway and Turnpike Association, spoke on the Ohio Turnpike Commission, which was formed in 1949.
Cleveland	October 20	68	Dinner meeting with Theodore J. Kauer, director, Ohio State Highway Department, discussing the state's highway problems.
Colorado	October 9	48	An illustrated lecture on "Underdrains for Canal Lining" was presented by Jack Shuster, hydraulic engineer, Bureau of Reclamation, Denver, Colo. Howard G. Curtis, head, pipelines and siphon section of the Canal Division, U.S.B.R., led discussion.
Duluth	October 16	16	Harry C. Walker, vice-president and general manager, Atkins-Walker Co., Duluth, Minn., reported on recent Local Section Conference in Chicago.
North Carolina	October 14	94	Fall meeting. Business session in morning. Technical session speakers included: Robert A. Flack, city manager, Durham, N.C., who spoke on social and economic trends of the times, and C. S. Reed, vice-president and rate engineer, Duke Power Co., Charlotte, N. C., who talked on power.
Pittsburgh	October 10	120	Joint meeting with civil section of Engineers Society of Western Pennsylvania. W. F. Swiger, engineer with Stone & Webster Engineering Co., Boston, Mass., discussed foundation investigations for the Elrama Power Station of the Duquesne Light Co.
San Diego	October 24	27	Vinton Bacon, executive officer of the California State Water Pollution Control Board, described pollution control policy of the regional boards.
Seattle	October 25	71	Federal water resource policies were outlined by J. Frank Ward, superintendent, light division of Tacoma Department Public Utilities.
Tacoma	October 10	28	J. Frank Ward, Tacoma Department Public Utilities, reviewed federal water resource policies.
Tennessee Valley Knoxville Sub-Section	October	...	Election of officers. Recent developments in pre-stressed concrete were described by Henry W. Dougherty, field engineer of Portland Cement Association, Memphis, Tenn.
Tri-City	October 18	26	C. J. Posey, head, department of civil engineering, State University of Iowa, spoke on the Rocky Mountain Hydraulic Laboratory.

Spokane—Meeting of the Columbia Branch in Walla Walla, Wash., December 14.

Syracuse—Meeting in Syracuse on December 14.

Tennessee Valley—Dinner meeting of Knoxville Sub-Section at the S & W Cafeteria, Knoxville, December 13, at 6:15 p.m.

Texas—Luncheon meetings of the Dallas Branch the first Monday of each month, at the Hotel Adolphus, at 12:15 p.m. Luncheon meetings of the Fort Worth Branch the second Monday of each month, at the Blackstone Hotel.

Wisconsin—Annual meeting in the Engineers Society of Milwaukee Building, Milwaukee, December 18.

Scheduled ASCE Conventions

WINTER CONVENTION
Houston, Tex., February 21-23
(Board of Direction meets February 19-20)

SUMMER CONVENTION
Louisville, Ky., June 13-15
(Board of Direction meets June 11-12)

ANNUAL CONVENTION
New York, N. Y., October 22-25
(Board of Direction meets October 20-21)

Strong enough EMPTY to support a 100-ton rig!

MONOTUBE
tapered steel piles

cut costs, speeded construction of Nueces Bay Causeway

THIS special pile driver was designed and built to overcome the hazards of gulf storms and delay as well as to reduce the use of costly water equipment. By spanning three driven bents, it could overhang sufficiently to drive the Monotube piles in the next bent, fifty feet away. Monotubes 90 to 125 feet in length were driven in record time.

The striking feature of this ingenious operation was the way light, *empty* Monotube steel piles, without any added lateral bracing, easily supported the 100-ton driver. Monotube's additional strength gave them the extra ability to withstand the weight, vibration and pulling action of the rig . . . in other words, loads in excess of those for which they were designed. *In fact, the entire foundation was thus completely pre-tested long before the Causeway's completion and use.*

Here again Monotubes' strength, flexibility, and economy features helped solve construction problems—and reduced costs. Strong, yet light in weight, they're easy to handle. Monotubes have a range of lengths, gauges, tapers and diameters for varying soil conditions and different types of structures. There's minimum cut-off waste . . . they're easily extendible. Jobs started with Monotubes can be *completed* with them.

On foundation work of all types, Monotubes offer extra savings from start to finish. For complete information, write The Union Metal Manufacturing Company, Canton 5, Ohio.

Nueces Bay Causeway, Corpus Christi, Texas. Built by Texas Highway Dept., in cooperation with Bureau of Public Roads, under direction of D. C. Greer, State Highway Engineer. Contractors, Austin Bridge Co.

UNION METAL

Monotube Foundation Piles

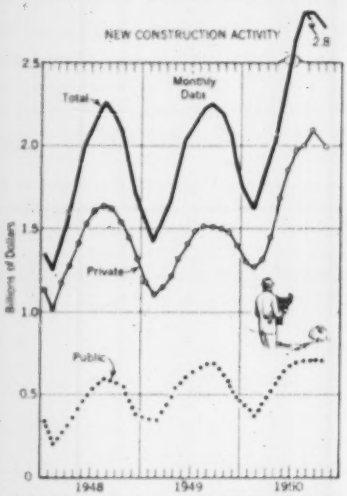
NEWS BRIEFS

Slight Drop in Construction Activity in October Reported

DESPITE INCREASES IN some types of building activity in October, a drop from the record rate maintained throughout the summer is reported by the Construction Division of the Department of Commerce and the U. S. Labor Department's Bureau of Labor Statistics. The total value of all types of new construction put in place during the month amounted to about $2.7 billion, 4 percent less than the September total, according to the joint agencies.

Much of the drop in total construction activity is attributed to a decline in private homebuilding and in highway construction. Gains over the September level, however, are reported for most types of nonresidential building, both private and public. Expansion of industrial and commercial building activity was particularly marked, reflecting the high rate at which contracts have been awarded during the past few months. Estimates of the value of new work put in place during the month are said to represent, for the most part, work started during earlier months, and to reflect to only a very limited extent the construction trends that may result from recent federal actions in the construction field.

New construction totals for the first ten months of 1950, with an estimated value of $22.8 billion, are 22 percent above the total for the same period in 1949. Of this total, nearly $9.5 billion was made up of outlays for new nonfarm dwellings—63 percent more than during the first ten months of last year. The amount of private nonresidential building was up about 10 percent from last year, and public construction up about 8 percent.



DEPARTMENT OF COMMERCE CURVES show slight drop in construction volume in October.

Contract Signed for Construction of Rio Grande Storage Dam

A CONTRACT FOR the construction of Falcon Dam and Power Plant on the Rio Grande was signed by the Commissioners on the International Boundary and Water Commission—I. M. Lawson, Hon. M. ASCE, for the United States, and David Herrera Jordan for Mexico. Located about 75 miles downstream from Laredo, Tex., the project will be the first and lowermost of the major international storage dams on the Rio Grande provided for by the February 1944 Water Treaty between the United States and Mexico. It will be built jointly by the two governments through the International Boundary and Water Commission.

C. F. Lytle & Co., and others, doing business as the Falcon Dam Constructors with main offices in Houston, is the successful bidder for the Schedule No. 1 Contract covering items allocated to the United States, and Constructora Intercontinental, SA, of Mexico, Mexico City, successful bidder for the Schedule No. 2 Contract covering the Mexican section of the project. The amount of the United States contract is $7,801,064 and of the Mexican about $7,922,080.

Both Falcon Dam Constructors and Constructora Intercontinental SA consist of the C. F. Lytle Co., Sioux City, Iowa; Foley Brothers, Inc., St. Paul, Minn.; Massman Construction Co., Inc., Kansas City, Mo.; Tellepsen Construction Co., Houston, Tex.; Edward Peterson Co., Omaha, Nebr.; San Ore Construction Co., McPherson, Kans.; and Amis Construction Co., Oklahoma City, Okla.

Falcon Dam is of rolled earth-fill construction, with a total axial length of 26,294 ft and maximum height of about 150 ft. An oil-surface roadway and sidewalk will be constructed along the entire length of the dam, with a beam-type guardrail along both edges of the crest for protection of traffic. Separate outlet works are provided for each country, and identical 10,500-kw power plants will be built on each side of the river near the downstream toe of the dam. The spillway is to be on the American side. Four 50 × 50-ft gates are designed to pass 456,000 cfs with reservoir full.

Philadelphia Plans New Public-Improvement Program

TO CARRY FORWARD the ambitious program of public improvements under way in Philadelphia, the City Planning Commission has submitted to the mayor a report recommending a new six-year improvement program to cost $426,961,500. Covering the period 1951–1956, the report schedules highway improvements, including the Schuylkill Expressway, completion of the Market Street Subway Extension, and placing in operation of the Locust Street Subway; waterworks improvements; completion of the sewage-collection and treatment system; building of incinerators; and construction of an airport terminal building.

Also included is an accelerated program of redevelopment of blighted areas and improvements to the city's health and welfare institutions. A major recommendation made for the first time in the program is for the acquisition of land and equipment for disposal of the city's non-combustible refuse, solving the problem for the next 30 years.

In a comparison with actual accomplishment over the past six years, the report shows that from 1945 to 1950 the city placed under contract $237,000,000 of public improvements. Though the recommended program for the next six years almost doubles this amount, a large part of the increase is represented by a $200,000,000 public housing program.

NACA Laboratory Builds New Research Facilities

THE NATIONAL ADVISORY Committee for Aeronautics will have new facilities for investigation of aerodynamic phenomena encountered in extremely high-speed flight, with completion of a $3,813,679 building project under way at the Langley Aeronautical Laboratory near Hampton, Va. The new facilities include a Gas Dynamics Laboratory, believed to be the largest and most complete in the United States, and an Internal Flow Laboratory. Five buildings of steel frame, brick, and reinforced concrete comprise the project, which is being constructed by the Rust Engineering Co., of Pittsburgh and Birmingham.

Indian Engineers to Have Large Exhibition in January

To SUPPLEMENT THE four international congresses scheduled for Bombay and New Delhi, India, during the month of January 1951, the Indian National Committee of the International Commission on Large Dams is assembling an engineering and industrial exhibition to be held in New Delhi from January 10 to February 10. International in character, the exhibition will show by means of models, maps, charts, photographs and films, and engineering materials, machinery and structures latest developments in the sciences and techniques covered by the international conferences. Exhibits being arranged by the Tennessee Valley Authority, the Department of the Interior, the Corps of Engineers, and other agencies, both government and private, will serve to strengthen United States-Indian relations.

The four groups holding conferences in India in January are the International Commission on Large Dams, the World Power Conference, the International Association of Hydraulic Research, and the newly formed International Commission on Irrigation and Canals.

Inquiries regarding entry rates for the exhibition should be addressed to the Advertising Section, Central Board of Irrigation, Mansingh Road, New Delhi, India.

Floating Derricks Place Huge Natural Gas Pipeline Under Harlem River

TEAMED TOGETHER IN single-line formation, three floating derricks with combined lifting capacity of 430 tons recently lowered a 568-ft, 173-ton rigid section of pipeline into a prepared trench at the bottom of the Harlem River between Manhattan and the Bronx at 135th Street. The operation constituted one of the last links in a $14,000,000 pipeline project to bring natural gas from Texas to the utilities serving the five New York City boroughs.

NATURAL-GAS PIPELINE SECTION is shown on Bronx side of Harlem River (upper photo, left) before it is lowered into river. In lower view sinking operation has begun. Steel girders and strongbacks, attached to pipeline to equalize strain during sinking, are visible.

Location of the pipeline in an area requiring absolute precision for clearance at certain points and for perfect alignment upon completion was the major problem rather than the weight of the pipe section. Perfect teamwork of the three dredges made it possible to lower the huge pipeline section into exact position without strain at any point, according to engineers for Merritt-Chapman & Scott, who had the contract for the operation.

Preliminary work consisted of dredging a 20-ft-wide trench approximately 35 ft below water surface. In some places the trench had to be blasted through rock. The day before actual sinking operations, three rigid steel girders or strongbacks, weighing 70 tons, were fastened to the pipeline by cable splicers to equalize stress and strain throughout.

The actual work of lifting the submarine gas main—a 30-in.-dia pipe of $\frac{1}{2}$-in. steel encased in a $3\frac{1}{2}$-in. jacket of reinforced-concrete—from its assembly position on the Bronx side of the river, swinging it broadside across the river, and maneuvering it into position in the trench required only six hours. The pipe was bent up about 50 ft at both ends at angles of 45 and 38 deg, respectively to stick out of the water on both the Manhattan and Bronx sides of the river.

Starting at 6 a.m. to take full advantage of tide conditions, the three 100-ft booms moving slowly in unison so that there would be uniform stress throughout swung the pipe clear of the dock and across the entire width of the river. After the line had been lowered a foot at a time onto the bottom of the trench, two divers went down to inspect the position of the pipe. Since the central section—452 ft 9 in. long, with a 50-ft 5-in. rise on the Manhattan side and a $66\frac{1}{2}$-ft rise on the Bronx side—was found to be resting firmly on the gravel base prepared for it, the divers unbuckled the release swings secured to the pipe, and burned off the end connections with oxy-hydrogen underwater cutting torches. When the temporary stiffening girders and strongbacks had been pulled away, the river was ready for normal marine transportation.

Special protective treatment given the line includes the addition of two extra wrappings of fibre glass and special enamel to the standard coating. In position on the bottom of the river, the pipe is covered with an 18-in. layer of coarse gravel and 24 in. of riprap. Connection with land pipes on each side of the river was made by welding. Though the line is designed to operate at 350 psi, operating pressure will vary during the first year from 50 to 275 psi.

Turnpike Authority Lets Contract for Rail Overpass

AWARD OF A contract for construction of the substructure for the overpass of the Oak Island yards of the Pennsylvania Railroad in Newark to the Underpinning and Foundation Co., of New York, is announced by the New Jersey Turnpike Authority. The contract (45A) amounts to $1,841,595.50.

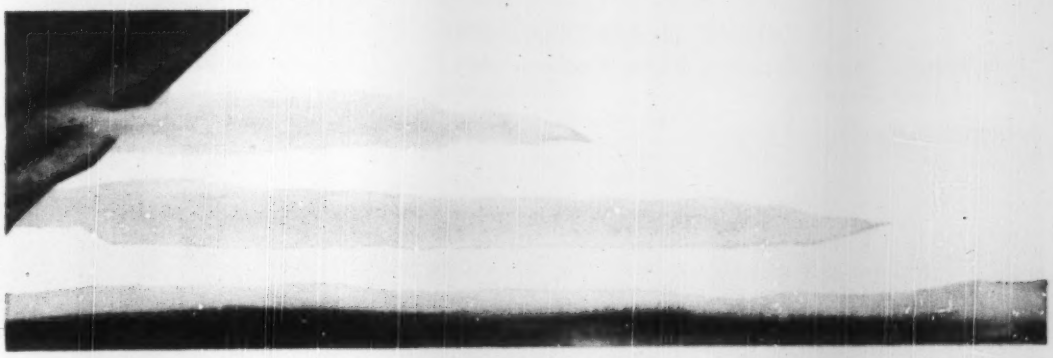
Cannonsville Dam Project Receives State Approval

PERMISSION TO CONSTRUCT a dam and reservoir at Cannonsville, N.Y., has been given the New York City Board of Water Supply by the State Water Power and Control Commission. Located on the West Branch of the Delaware River, Cannonsville Dam constitutes the third stage on the city's Delaware Basin water system now under construction. In granting approval for the project, the Commission rejects the Beck plan to take water from the Hudson River (March 1950 issue of CIVIL ENGINEERING, page 62).

Before construction of the Cannonsville project can begin, the approval of the United States Supreme Court will also be required. In making its decision, the Supreme Court will have before it the proposed four-state Delaware River Basin Compact (October 1950 issue of CIVIL ENGINEERING, page 58). When confirmed by New York, New Jersey, Pennsylvania, and Delaware and approved by Congress, the Compact would give power to a Delaware River Basin Commission to construct and operate the water resources of the basin, including a reservoir on the West Branch of the Delaware at Cannonsville.

New York seeks to connect the 360-mgd Cannonsville Project by tunnel to the city's Delaware Aqueduct System, which terminates at present in Rondout Reservoir. The estimated cost of the project is $140,000,000, and the construction time ten years.

Johns-Manville



tax savings for the future

Three billion, two hundred and fifty million dollars*—that's what it will take to foot the bill for new water system construction so urgently needed by the American people during the next ten years!

For the thousands of communities that must carry a share of this additional investment, the vital need for water system expansion is most unwelcome at this time in the face of constantly rising costs.

This means that, wherever possible, water works officials will be called upon to keep an exceptionally close watch on expenditures . . . to see that the money laid out for new systems brings the greatest possible return to the taxpayer.

Since a sizable part of the cost of any water system involves the supply and distribution lines, an important question to be answered by these officials will be: "Which pipe will give the greatest return from this portion of our investment?"

Thousands of communities have already found the answer to this question in Transite Pressure Pipe.

A threefold warranty of economy is built into every length of Transite Pressure Pipe . . . the modern pipe developed by Johns-Manville through research and engineering to carry water more efficiently:

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2. ***Low operating costs*** . . . because Transite Pipe has a smooth interior surface which provides a high water-carrying capacity (C=140). Moreover, because Transite cannot tuberculate, this high carrying capacity *remains* high through the years. Pumping costs, as a result, stay low. Delivery of a full volume of water at lowest operating cost is assured.

3. ***Maximum water economies*** . . . because Transite Pipe has tight, yet flexible joints that *stay* tight in service. These joints absorb vibration and soil stresses, cut down on costly underground water leakage. This is especially important today when water supplies in many localities must be conserved to the limit to meet constantly increasing water consumption.

In addition to these assurances of tax savings for the future, Transite Pressure Pipe offers many *immediate* economies, such as important savings in time and money during installation . . . further sound reasons why it will pay you and your community to specify Transite for the greatest return from your pipe investment.

*From THE WALL STREET JOURNAL, May 26, 1950

For complete information write Johns-Manville, Box 290, New York 16, N. Y.

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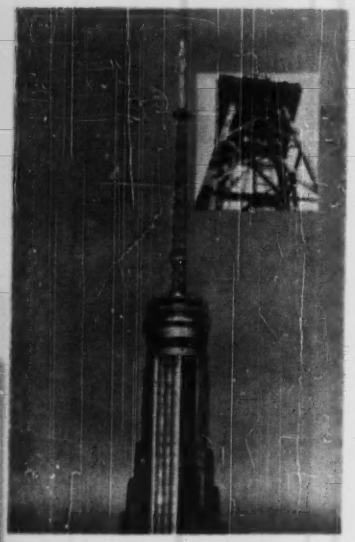
Television Tower Tops Tallest Building



TELEVISION TOWER, nearing completion atop Empire State Building in New York City, will increase height of world's tallest structure by 222 ft, bringing total height of building to 1,472 ft. Designed to withstand winds of 110 mph, new tower utilizes portion of building above 87th floor originally intended as dirigible mooring mast. Superstructure (shown in closeup view in inset) includes 97 tons of prefabricated structural steel, which was assembled in sub-basement of building and carried, piece by piece, up elevator shafts under the elevator cars. Use of horizontal bracing, at from 7 to 10-ft vertical spacing, prevents buckling of the tower due to its slenderness. Braces are detailed to keep corners free for running cables and conduits up the legs. Pole for NBC Super Turnstile antenna will be assembled inside tower base and hoisted vertically into place, eliminating need for boom or gin pole. Edwards & Hjorth, New York structural engineers, are consultants on project, and Starrett Brothers & Eken, contractors. American Bridge Co. is structural steel builder.

Production of Aluminum Reaches Six-Year High

PRODUCTION OF PRIMARY aluminum in the United States during the third quarter of 1950 reached the highest level since the second quarter of 1944, according to Donald M. White, secretary of the Aluminum Association. "Even with this high rate of production," Mr. White warned, "the industry is unable to supply all the metal desired by civilian users after meeting our mounting military needs."

The 371,945,743-lb total for the third quarter topped the year's second-quarter production by about 3 percent, he stated.

Moles Announce 1951 Construction Awards

TWO PROMINENT CONTRACTORS have been selected by The Moles to receive their eleventh annual awards "for outstanding contributions to construction progress." The member award winner is Ray N. Spooner, M. ASCE, treasurer of Allen N. Spooner & Sons, Inc., New York City, and the non-member winner Lester S. Corey, president of the Utah Construction Co., San Francisco. Presentation of the awards, consisting of plaques and citations, will take place at the organization's annual dinner at the Waldorf-Astoria Hotel in New York on January 31.

Each year The Moles, an association of leaders in the heavy construction industry, honor one member and one non-member. Mr. Spooner is famed in New York as the builder of three of the city's largest North River piers, which involved mastery of difficult and unforeseen rock conditions. Mr. Corey has been closely associated with the direction and management of construction of such famous dams as Grand Coulee, Bonneville, Hoover, and Davis, which is now nearing completion on the Colorado River. Recently his firm was awarded a $32,000,000 construction contract to build Big Eildon Dam in Australia.

Ray N. Spooner

Lester S. Corey

Burlington Railroad Shortens Main Line by Cutoff Project

A MAJOR RAILROAD project, currently under construction by the Chicago, Burlington & Quincy Railroad in western Missouri, will reduce the length of the railroad's main line between Chicago and Kansas City by approximately 21 miles. Shortening of the line, together with improvement of the grade and alignment, will reduce the present passenger train schedule between the two terminals from 12 to 8½ hours and also result in the saving of considerable time in freight service.

As shown in Fig. 1, the present main line, beginning at Kansas City, runs almost straight north to Cameron Junction and then east to Laclede. The new line follows a northeasterly direction from Birmingham, just north of Kansas City, to Laclede, saving some 21 miles. To effect this cutoff, the Burlington Railroad, by agreement with the Wabash Railroad, will use the latter's line a short distance east of Birmingham. Estimated to cost approximately $16,000,000, the project involves the construction of some 50 miles of entirely new line between Missouri City Junction and Tina Junction and the improvement, amounting to almost complete reconstruction, of the existing branch line from Tina Junction to a point between Laclede and Brookfield.

The project follows rolling terrain. The western portion of the new line is characterized by fairly heavy grading, with cuts up to 95 ft and embankments [illegible] high. For this rocky portion of the project, 18 possible lines were surveyed and analyzed as to construction, economy, and gradient control before final adoption of the line chosen. Excavation of some 700,000 cu yd of rock is required in this area, with the project as a whole involving more than 7,000,000 cu yd of excavation.

The project includes a total of 45 bridges and grade-separation structures. Of these, 25 are of permanent steel and concrete construction. For overflow structures and at locations where there is uncertainty as to potential flow, creosoted timber trestle construction is provided, with the intention of subsequent replacement with permanent construction after requirements have been more fully established. Cost of the bridges and numerous culverts will be about $4,000,000.

Curvature on the new line is held to a minimum and the maximum gradient is 0.8 percent. With diesel power predominating on the railroad and complete conversion to diesel scheduled for the near future, this grade is considered quite satisfactory. For analysis of soils and control of embankment compaction, a well-equipped laboratory has been set up by the railroad.

The project is scheduled for completion in the fall of 1951, with rail traffic to be routed on the new line by January 1, 1952. H. R. Clarke, M. ASCE, is chief engineer of the Burlington Railroad, and Assistant Chief Engineer H. A. Aalberg is in direct charge of the project.

Material for this release was supplied by Josef Sorkin, M. ASCE, member of the firm of Howard, Needles, Tammen & Bergendoff, Kansas City, Mo., who represented ASCE at a recent special inspection of the cut-off project.

FIG. 1

FIG. 1. PRESENT MAIN LINE begins at Kansas City and runs almost straight north to Cameron Junction and then east to Laclede. New line follows northeasterly direction from Birmingham to Laclede, effecting saving of some 21 miles.

NEW PHOTOGRAPHIC MATERIALS...
NEW DRAFTING SHORT CUTS

Eliminate Costly Retracing

at INGERSOLL-RAND
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Instead of making expensive "ink on cloth" tracings of its original drawings, Ingersoll-Rand simply reproduces them on Kodagraph Autopositive Cloth. This new photographic material produces positive copies *directly* (like Kodagraph Autopositive Paper and Film) . . . without the negative step . . . without darkroom handling. No special equipment is required, either: a photocopy machine is used for the exposure operation . . . standard photographic solutions for development. *Result:* intermediates that have the sharpness, the sparkle of new ink tracings . . . with non-smudging, dense photographic black lines on a durable white cloth base.

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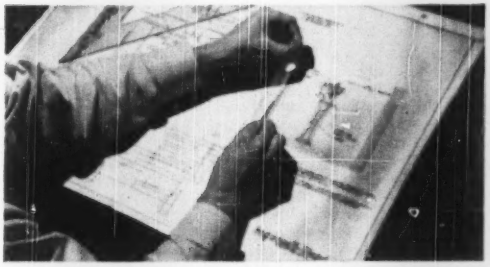
When such drawings are taken from the files, the call is for Kodagraph Autopositive Paper—to eliminate hours of expensive retracing time. This low-cost, high-contrast photographic material increases line density . . . cleans up backgrounds . . . in many cases delivers serviceable intermediates that require no handwork at all. Drawings in very poor condition are restored by Ingersoll-Rand in the following manner: after an "Autopositive" is made, stains, creases, and other unwanted elements are removed with eradicator fluid or razor blade. Then, the print is used to produce a second "Autopositive," which is touched up with pencil if necessary.



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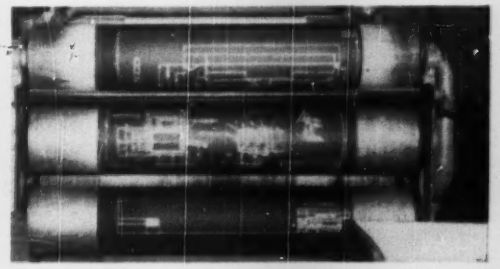
Among the many ingenious drafting short cuts developed by Ingersoll-Rand is the use of Kodagraph Autopositive Film overlays made from standard-component drawings. These transparencies are kept on file . . . and taped to new drawings whenever necessary. Following this, the composite is reproduced on Autopositive Paper. *Result:* a photographic intermediate of uniform line density . . . plus important savings in drafting time.



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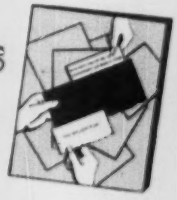

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Cooperation Stressed at Virginia Highway Conference

A STRONG PLEA for cooperation in the effort to solve Virginia's "challenging highway safety problem" was made by Virginia Governor John S. Battle at the recent fourth annual Virginia Highway Conference, held at Virginia Military Institute in Lexington. Governor Battle said that if the state must amend its traffic laws to cope with the problem, it should not hesitate to do so, "but I think strict observance of the laws we now have will do the job."

Other featured speakers included Virginia Senators Harry F. Byrd and A. Willis Robertson, and Maj. Gen. Philip B. Fleming, M. ASCE, permanent chairman of the President's Highway Safety Conference. The most disturbing aspect of the highway safety problem is "the surging tide of rural traffic fatalities," General Fleming told the group. He pointed out that last year's death toll on rural roads was 22,000 as against 9,500 killed in urban areas, and warned that "if we permit this trend to continue, it will more than overshadow hard-won gains we have been making on other sectors of the highway safety front."

Virginia Highway Commissioner James A. Anderson, M. ASCE, sounded the conference keynote in an address entitled "One Highway System—One Highway Problem." The "one highway system does not stop at county lines or corporate limits," he declared. "It can be prosperous only when each and every mile, wherever located, is in condition to do the work it is called on to do." Five principal lines of approach to the urban traffic problem were recommended by Joseph Barnett, M. ASCE, urban design engineer for the Bureau of Public Roads. He called for improvement of arterial routes in the cities; improvement of the general street system; improvement of public transportation systems; development of adequate parking facilities; and better use of facilities now available.

More than 600 road engineers and public officials registered for the two-day program, which also included special group meetings on various aspects of the highway problem, a number of exhibits, and a dinner at which Senator Byrd spoke.

First Tests of Axle Loads on Pavements Are Reported

TRUCKS WITH HEAVY axle loads rolling over a mile of Maryland highway, designated Road Test One—Md., are piling up facts and figures pertinent to the long-running debate over the weight vs. highway life relationship. The test conducted by the Highway Research Board includes four lanes, each about half a mile long. Lanes I and II, which are parallel lanes of a two-lane concrete highway that has been in service about nine years, are tested under 18,000-lb and 22,400-lb single-axle loads respectively. Lanes III and IV, like I and II, are half-mile parallel strips of the same two-lane highway and carry loads of 32,000 and 44,800 lb respectively on tandem axles. To October 31, Lane I had developed 135 ft of cracks under about 180,000 truck applications, Lane II 726 ft under 172,000 applications, and Lane III 597 ft under 114,000 truck applications. Lane IV, with 3,393 ft of cracks after 92,000 applications, was eliminated from the test on October 13, cracking having progressed so that further traffic was deemed inadvisable. As yet, no conclusions can be drawn, and the final report will not appear until after the close of the test.

During the tests careful records are kept of the location and date of each crack as it occurs. Likewise, a raingage at the site records the amount of rain at the test location, as this figure is highly significant to the results of the test. Bench marks put in by the U. S. Coast and Geodetic Survey serve to keep a continual check on elevations of the pavement. Upon completion of the test, sections of the pavement will be removed and extensive tests made on the concrete itself and the subgrade under the test strip. Electronic counters placed along the strip keep a record of the number of trips made on each pavement. The loaded trucks drive back and forth over their test strips continually for 50 minutes of every hour, 24 hours a day. Strain-gage measurements are being made along the test strip, and strain gages are measuring the warping stresses caused by the temperature differential between the top and bottom of a slab not in the test section.

During the tests the only maintenance is the regrading of the shoulders and the sealing of the expansion and contraction joints. Cracks due to failure of the pavement are not sealed. When a slab settles to the point of endangering the test vehicles, the point of failure is resurfaced with asphalt, and that particular point is no longer considered in the test.

The cost of the test is being shared by the states of Connecticut, New Jersey, Delaware, Pennsylvania, Ohio, Michigan, Illinois, Wisconsin, Kentucky, Virginia, Maryland, and the District of Columbia. Test vehicles are being supplied by automobile manufacturers, and gasoline, oil and grease by the petroleum industry. Personnel and equipment for testing and instrumentation are supplied by the Bureau of Public Roads. The project is administered and supervised by the Highway Research Board through a project executive committee and an advisory committee made up of representatives of the participating agencies.

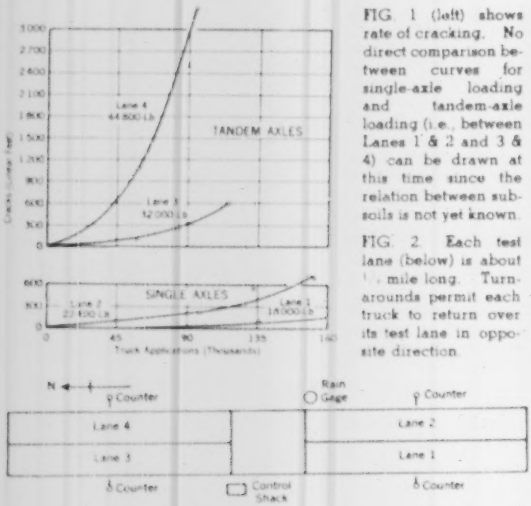
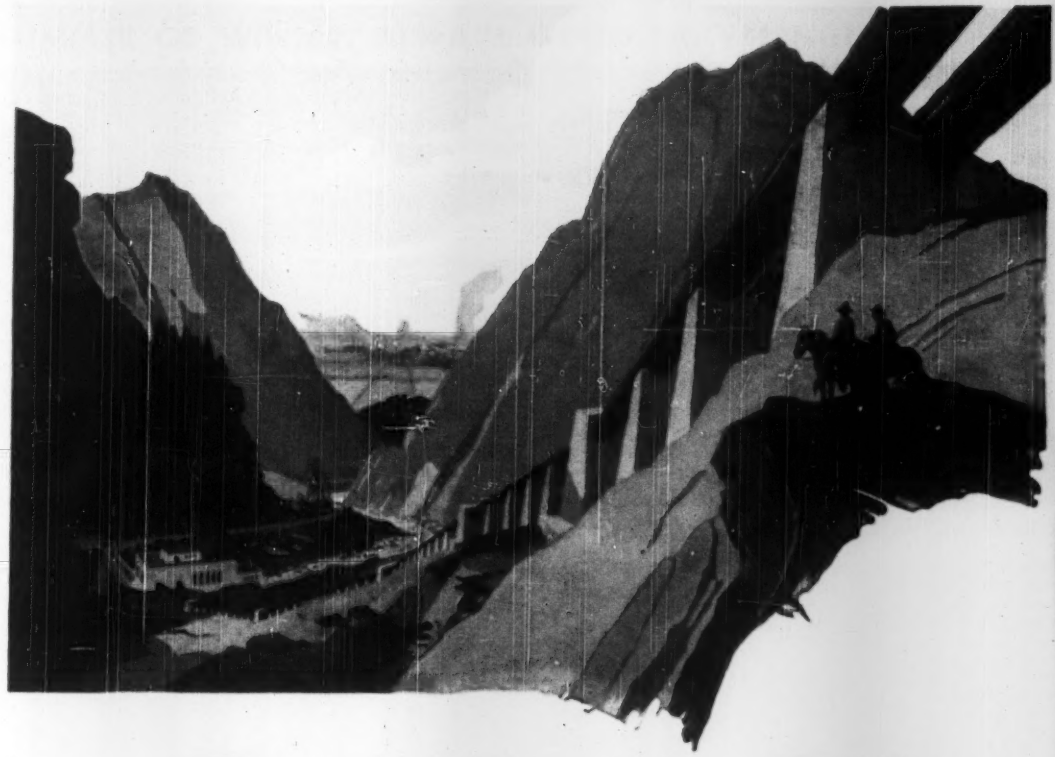


FIG. 1 (left) shows rate of cracking. No direct comparison between curves for single-axle loading and tandem-axle loading (i.e., between Lanes 1 & 2 and 3 & 4) can be drawn at this time since the relation between subsoils is not yet known.

FIG. 2. Each test lane (below) is about ½ mile long. Turnarounds permit each truck to return over its test lane in opposite direction.

TRUCK CARRYING 44,800 lb on tandem axles speeds over test Lane IV of Highway Research Board's Road Test One—Md. Note open crack along edge of pavement due to pumping. Light lines across pavement are painted lines indicating location of cracks. Different colors are used to show period in which crack occurred.



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Impulse runner of solid-cast design, an exclusive SMITH advantage.

FOR HIGH HEADS, and wherever the head and water quantities available prohibit the use of reaction-type machines. Ideal for installations in remote localities because of the ease with which the completed unit may be transported. The simplicity of design, facility of operation and greater dependability remove the necessity of skilled operators and attendants. Smith's solid-cast runner design provides the additional advantages of closer spacing of buckets resulting in increased speed and consequently, a decrease in the size of the turbine unit, as well as the generator. Write for your copy of our Bulletin — "Impulse Turbines by SMITH!"

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POWER by SMITH

Seven-Mile Belt Moves Aggregate for Dam Construction

MAMMOTH JOB OF MOVING 4,000,000-TON MOUNTAIN by belt conveyor across rugged Ozark Mountain terrain to build stockpile for use in construction of Bull Shoals Dam in northern Arkansas is scheduled for completion in few weeks. Speeding construction of project, belt conveyor (right foreground) carries aggregate from rock crusher to stockpiles on side of Lee's Mountain, from where it is transported seven miles to dam site by means of 21-section belt (center). Powered by 14,000 idlers, belt travels at rate of 525 fpm and has carrying capacity of 650 tons per hour. When completed in autumn of 1951, the $78,000,000 Corps of Engineers project will be fifth largest dam in world. It will provide flood control for 1,000,000 acres of land and supply power to Tulsa, Okla., Springfield, Mo., and Little Rock, Ark.

Technical Group Studies Helmand River Situation

THE EMBASSIES OF Afghanistan and Iran have announced the departure of an international technical commission, called the Helmand River Delta Commission, for Afghanistan and Iran to make engineering studies and render an advisory report to the two governments on problems of mutual interest connected with the Helmand River. Organized by agreement between the governments of the two countries with the help of the U. S. Department of State, the Commission consists of a panel of experts on river water problems—Francisco Dominguez of Chile, Christopher E. Webb of Canada, and Robert L. Lowry, M. ASCE, consulting engineer of El Paso, Tex. Engineer-secretary for the group is Malcolm H. Jones, Assoc. M. ASCE, on loan from the Bureau of Reclamation.

Postwar economic development programs in both countries have served to point up matters of mutual interest connected with the water uses of the river. In particular, the water shortages caused by the unprecedented droughts of 1946 and 1947 led to a request for the aid of the United States in assisting the two governments to set up a neutral international commission that could make studies and recommendations to assist the two countries in their negotiations.

Prizes Announced in Welded Bridge Design Competition

THIRTEEN AWARDS TOTALING $10,750 are announced by the James F. Lincoln Arc Welding Foundation in its 1950 Welded Bridges of the Future Program for design of an all welded 250-ft highway bridge, for which minimum specifications as to loads and type of steel were outlined. Designers from 16 different countries submitted entries in the contest, which is intended "to promote the building of better bridges for less money and with less steel."

Winner of the first award of $5,000 is James H. Jennison, Assoc. M. ASCE, head of the Development Engineering Division of the U. S. Naval Ordnance Test Station at Pasadena, Calif. The second award of $2,500 goes to Ernst Amstutz, of Zurich, Switzerland, and third award of $1,250 to Thomas C. Kavanagh, Assoc. M. ASCE, professor of civil engineering at Pennsylvania State College. Mr. Jennison has been winner in two previous contests, and Professor Kavanagh took first award in the 1949 competition. Recipients of the ten Honorable Mention awards include Arsham Amirikian, M. ASCE, head designing engineer for the Navy Department, Washington, D. C., and John A. DeLong, Jun. M. ASCE, and A. A. Brielmaier, M. ASCE, both of St. Louis.

Steel Company to Enlarge Its Production Facilities

RECORD EXPANSION OF its steel-making capacity by construction of new facilities is announced by the Armco Steel Corp., Middletown, Ohio. Work has just started at Middletown on a new $12,000,000 open-hearth plant, which will have a capacity of over 400,000 tons of steel ingots a year and represent the last word in steel-making. In addition, the organization is planning a $35,000,000 project for improvement of its East Works plant at Middletown, which will include construction of one of the largest blast furnaces in the world.

Construction and modernization programs are also under way at company plants at Houston, Kansas City, and Ashland, Ky.

Planning Advances Must Meet New Defense Criteria

ADOPTION OF NEW criteria for the second Advance Planning Program for non-Federal Public Works to relate it more directly to the defense program is announced by the Housing and Home Finance Agency. According to Administrator Raymond M. Foley, the action taken is in line with the President's recent directive that all civilian public works programs be reviewed and limited to defense needs and essential civilian requirements. The new criteria are "(1) whether projects contribute directly to defense operations, or (2) whether projects meet essential and immediate civilian requirements."

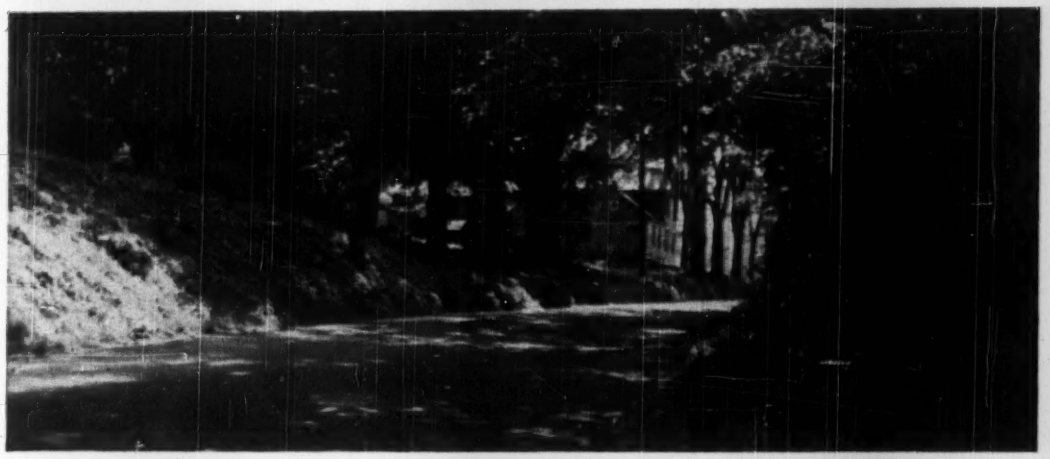
Approximately 700 applications now on file in Community Facilities Service district offices and the central office in Washington will be restudied against the new criteria governing planning advances. Savings permitted by redirection of the program are estimated to be at least $15,000,000.

Decline in Dollar Volume of Building in 1951 Foreseen

BUILDING AND ENGINEERING contracts in 1951 will decline 19 percent from the 1950 high in the 37 states east of the Rockies, according to recent estimates of the F. W. Dodge Corp., construction news and marketing specialists, published in the *Architectural Record*. The estimates—prepared jointly by Thomas S. Holden, president of the company, and Clyde Shute, assistant vice-president in charge of the statistical and research division—emphasize the fact that, "This is a cut-back from the peak construction volume of all time. It leaves a dollar total measurably greater than that of any year except 1950, and a physical volume total that would compare favorably with other prosperous construction years."

Little change is predicted in the level of construction costs in 1951. The demand for building labor is expected to ease somewhat with the reduced construction volume, though a shift from construction to defense production employment is anticipated.

SUMMER OR WINTER, ALWAYS GOOD TRAVELING!



When summer suns beat down, roads built with TARVIA* road tar are glare-free, easy on the eyes, and pleasant to ride on. They blend with any landscape, and do not wave, roll, push, or bleed. Self-healing, they stay smooth without constant care.

When winter's storms of snow and ice come, roads built with TARVIA road tar are more easily kept open for use, for their heat-absorbing black surface melts snow and ice. Moreover, TARVIA road tar is not affected by calcium chloride or sodium chloride.

Tires find a surer tread for safer driving on the slightly granular, "tractionized" surface of roads built with TARVIA road tar.

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California Bridge Designers Look to Prestressing

LETTING OF A contract for a prestressed pedestrian bridge across the Arroyo Seco in the Los Angeles area marks the entry of the California Division of Highways in the field of prestressed concrete. The bridge, actually only an 8-ft sidewalk with clear span of 110 ft, was thought to be ideal as a starter in prestressed structures since it carried moderate live loads not subject to extreme overloading and was located in an accessible area for experimental work. As the bridge is primarily experimental in nature, the plans did not give specific details as to the size, number, or strength of wires, wire enclosures, distribution and design of anchorage plates, or jacking.

The low bidder, Walter Kaucher of Los Angeles, proposes to have the Prestressed Corp. of Kansas City do the prestressing. The bid price for the prestressing item was $5,000, and low bid for the entire project was $23,770.

Engineers for the California Division of Highways on the project are F. W. Panhorst, M. ASCE, assistant state highway engineer—bridges, and Leonard C. Hollister, M. ASCE, engineer of design for the Division.

R. Robinson Rowe, M. ASCE

"PROFESSOR NEARE," BEGGED Joe Kett, "before you ask me for my answer to the saucerigation problem, I want to know something about algebra."

"You surely should, Joe, but this was Guest Professor Nagle's problem and he'll do the asking."

"Well then, Professor Nagle, if the east and north positions of Leif Hopper's discflagship are represented by the coordinates (x, y) at 1:00 and (u, v) at 1:01, your problem reduces to finding (x, y) in the equations

$$(v-5)(x-33) = (u-5)(y-19) \quad (1a)$$
$$(v-1)(x-29) = (u-3)(y-1) \quad (1b)$$
$$(v-5)(x-37) = (u-1)(y-11) \quad (1c)$$
$$v(x-18) = u(y+16) \quad (1d)$$

"There are four simultaneous equations in four unknowns, for which there should be 16 solutions, but when I eliminated u and v, I had two quadratics in x and y with only four solutions left. What happened to the other twelve?

"I kept at it, eliminating x to find

$$y^4 - 11y^3 - 318y^2 + 1,736y = 1,408 \quad (2)$$

for which $y = 1$ is an obvious solution, but then Fay, that's my wife, drafted me to address Xmas cards."

"Too bad," chided Cal Klater, "when you were just about to get the wrong answer. However, your equations are all right, the four solutions to (2) being $y = -16, 1, 4, 22$. The first two are redundants which would nullify 1*d* and 1*b*. For a choice between the others, remember the navigator's axiom that constant bearing of an approaching vessel means collision. The map (Fig. 1) shows that the third solution would involve two collisions before 1:01, not to mention one which would have occurred before 1:00. So $y = 22$ and $x = 12$."

"Just so, Cal," commended Professor Nagle, "but Joe's question is still unanswered. If the operations indicated in Equations 1 are performed and any one equation subtracted from the other three, the quadratic terms vx and uy disappear, so that the set is not four independent quadratics, but three linears plus one quadratic for which there should be just two solutions. Each solution involves four collisions, but the times were set so that only one course postponed its collisions until after the target area was reached."

"You should have made them pay for that lesson in algebra, Stoop. Thanks. When Joe spoke of Xmas cards, it reminded me of what happened in Swutchburg, so named because of the many Dutch families and more Swedes. Each Dutch family sent a card to each other Dutch family but none to Swedes, and the Swedes exchanged cards in the same way. Last year a flood got into the postoffice and obliterated all the addresses, so the postmaster simply divided them up at random, each family receiving 508 cards. How many Swedish families lived in Swutchburg?"

[Cal Klaters were Richard Jenney, Ed C. Holt, Jr., Anne Othernut (J. Charles Rathbun), Don T. (Donald Thayer) and Charles G. Edson. Guest Professor Stoop Nagle is John L. Nagle. Also acknowledged are solutions to the September rooster problem from John Orth Cook and Abbot A. Sackheim.]

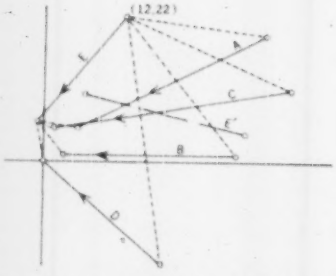


FIG. 1. **LEIF HOPPER (E) PARADES his flotilla at constant azimuth, but E' would have broken two saucers.**

Meetings and Conferences

American Association for the Advancement of Science. Programs in all principal fields of science have been scheduled for the meeting of the American Association for the Advancement of Science in Cleveland, Ohio, December 26–30.

American Institute of Electrical Engineers. Advances in the field of electricity will be discussed during the winter meeting of the American Institute of Electrical Engineers, at the Hotel Statler, New York City, January 22–26.

National Research Council. The annual meeting of the Highway Research Board of the National Research Council will be held in the National Academy of Sciences and the National Research Council Building, Washington, D.C., January 9–12.

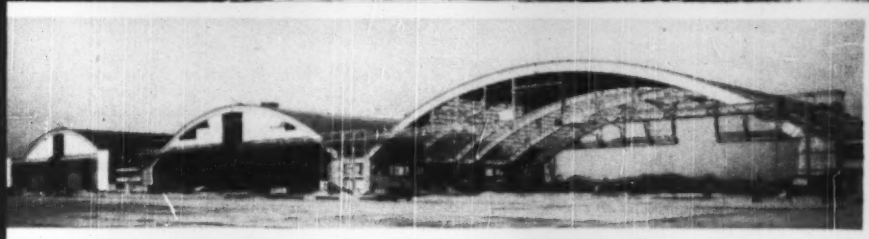
Harry George Appel (M. '30) died at his home in Pittsburgh, Pa., on October 28, at the age of 62. In 1910 Mr. Appel entered the employ of the City of Pittsburgh Department of Public Works, and in 1922 became connected with the Works Department of the County of Allegheny, taking an active part in the prosecution of its ten-year program of design and construction of new bridges over the Monongahela, Allegheny, and Ohio rivers. At the conclusion of this work he remained in bridge maintenance work for the county, and for a number of years prior to his death was specifications writer. He was a member of the first night class in civil engineering to be graduated from the Carnegie Institute of Technology.

Lucian Harrison Beebe (M. '36) who recently retired as resident engineer of the Connecticut State Highway Department, at Norwich, died on October 6. His age was 62. A pioneer in the development of Connecticut's highway network, Mr. Beebe acted as assistant to the late John A. Macdonald, state highway commissioner. He joined the highway department in 1924 and was assigned to the Norwich office in 1931. From 1936–1938 he was engineer in charge of the construction of the Middletown-Portland Bridge over the Connecticut River.

Ralph Augustus Beebee (M. '18) civil and structural engineer, of Oakland, Calif., died there on June 14. He was 67. As an engineer for the Federal Telegraph Co., Mr. Beebee installed wireless apparatus in California, Texas, and Illinois. In 1923 he was engaged by the City of Oakland, Calif., as harbor engineer. He then became chief engineer for the Berkeley Water Front Co., on work which included seawall construction and second-order triangulation services.

(Continued on page 72)

HUGE STEEL-ARCH HANGARS go up fast!



▲ Principal roof members are curved, riveted plate girders. Pinned at supports and crown, they have a constant depth, back to back of flange angles of 5 ft. 7 in. and rise 49 ft. 11 in. to provide a clear height at center of 75 ft.

◀ Interconnected by 2-story steel frame lean-tos ranging in width from 39 to 103 ft., the hangars form a building 1,148 ft. long and 219 ft. wide. Each hangar provides a 300 ft. clear floor space.

302′ Steel-Arch Spans SIMPLIFY ERECTION . . .

PROVE MOST ECONOMICAL TYPE OF CONSTRUCTION

PROJECT: Three hangars and interconnecting lean-tos at New York International Airport, Queens, New York City.

DESIGNED BY: Port of New York Authority, Roberts and Schaefer Company, Consulting Engineers, Lorimer and Rose, Associate Architects.

GENERAL CONTRACTOR: Stock Construction Corporation.

STRUCTURAL STEEL: 3,600 Tons. Fabricated and erected by American Bridge Company.

Erected in 13 months (complete with heating, fire-alarm and lighting systems) the three giant, 300′-wide, 219′-long hangars with interconnecting 2-story lean-tos have set a record for this type of construction—both as to length of spans and speed of construction.

Erected in four sections, the 302′-steel arches are pinned at the supports and crown to provide a clear height at the center of 75 ft. Each hangar is large enough to accommodate 6 Douglas DC-6 transports or four double-deck Boeing Stratocruisers. In addition, parking aprons on both sides of the building can take 15 aircraft of the type having a turning circle of 175 ft., or 19 of the smaller type having a turning circle of 150 ft.

The decision to use long panels between solid web steel arches for this important project was made after studied consideration of other types of construction materials. And again steel proved most economical by meeting all comers in competitive bids.

If you'd like to know more about the advantages of American Bridge Company *fabricated* and *erected* steel construction, just call our nearest office.

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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

AMERICAN BRIDGE

UNITED STATES STEEL

Deceased

(Continued from page 70)

Joseph Oakley Brown (Assoc. M. '20), president of the engineering and construction concern of Todd & Brown, New York City, died on October 14, at the age of 62. In 1919 Mr. Brown was named vice-president of Todd, Robertson & Todd Engineering Co. and in 1920 organized Todd & Brown. He directed construction and engineering for the restoration of Williamsburg, Va., and was engaged as consultant on the construction of Rockefeller Center. During the recent war he designed several ordnance plants for the armed forces. He was a New York University graduate.

Thomas Morris Burns (Assoc. M. '31), assistant manager, sales engineering, Alco Products Division of the American Locomotive Co., with headquarters in New York City, died there on August 19. He was 65. Earlier Mr. Burns had been connected with Thomas B. Bryson, Cleveland, Ohio, contractors; the New York City Board of Transportation; the Pacific Coast Engineering Motor Sales Co., of San Francisco, Calif.; and T. A. Gillespie, general contractors of New York, N.Y.

John Simpson Dodds (M. '27), professor of civil engineering, Iowa State College, Ames, Iowa, died on November 3. He was 65. Professor Dodds began teaching at Iowa State College in 1912 and became professor of civil engineering in 1934. To give students more practical experience in surveying, he established the summer engineering camp in Minnesota. He had been head of the educational department of the Iowa Highway Commission, and held membership in several honorary engineering societies and civic organizations. For a number of years he served as chairman of the ASCE Executive Committee of the Surveying and Mapping Division and as secretary of the Iowa Engineering Society. He received his B.S. and C.E. degrees from Iowa State College.

I. S. Dodds

Claire Ansel Downing (M. '39), executive secretary of the New York State Bituminous Concrete Producers Association, Albany, N.Y., died there on July 27, at the age of 51. Earlier Mr. Downing had been technical service engineer for the Universal Atlas Cement Co. and engineer in charge of the Municipal Testing Laboratory for the City of St. Louis, Mo. He was a member of the Association of Asphalt Paving Technologists, the American Concrete Institute, the American Society for Testing Materials, and Pi Kappa Alpha. He was a Kansas State College graduate.

William Elmhirst Duckering (M. '22), since 1935 dean of engineering at the University of Alaska, at Fairbanks, died there on October 7, at the age of 68. Dean Duckering went to the University of Alaska in 1932 as professor of engineering. Earlier he had served on the faculties of the University of Washington, Iowa State College, and the University of British Columbia. He had also been engaged in railroad engineering and as bridge design engineer of King County, Washington. He was educated at the University of Washington.

Martin Rankin Fisher (M. '27), deputy city engineer of Detroit, Mich., and former president of the Michigan Section of ASCE, died at his home on October 30, at the age of 66. Mr. Fisher had been in the City Engineer's office for the past 39 years, starting as a chief of field party. During World War I, he was plant engineer at the Hog Island Shipyards. Earlier in his career he was an engineer on the construction of the Michigan Central Railroad tunnel under the Detroit River and filled engineering assignments with several other lines. He received his engineering training at the University of Michigan.

Merle Haun Godwin (Assoc. M. '41), senior bridge engineer-maintenance for the State Department of Public Works, at Sacramento, Calif., died on October 28. He was 53. Upon his graduation from the University of California in 1927, Mr. Godwin became draftsman and designer for Napa County, Colorado, on road and bridge work. A year later he joined the California Division of Highways, serving successively as assistant resident engineer, junior designing engineer of bridges, associate bridge engineer, and senior bridge engineer-maintenance.

Frederic George Healy (Assoc. M. '17), former state highway engineer for the New Mexico State Highway Department, died in Santa Fe on October 20, at the age of 66. Mr. Healy had served the New Mexico Highway Department in various capacities from 1921 until his retirement last May. He was a graduate of Rensselaer Polytechnic Institute.

Richard Willis How (M. '10), civil engineer, at Castile, N.Y., for the past 15 years, died on October 11, at the age of 76. For some time Mr. How was with the Long Island Railroad as inspector, chief inspector, and assistant engineer in charge of design and construction of structures. He also acted as district engineer for the Bishop Engineering Co. on development work in Fort Pierce, Fla., and from 1927 to 1933 served the Genesee State Park Commission of New York, as engineer. He received his engineering training at Columbia University.

Robert Shelton Hughes (M. '44), designer and estimator with the American Bridge Co., Minneapolis, Minn., died recently. His age was 64. Mr. Hughes began his engineering career with the Minneapolis Steel and Machinery Co. in 1907, and later was with the Manitoba Bridge & Iron Co., of Winnipeg, Canada. For the past 34 years he had been employed by the American Bridge Co. in various capacities.

Harry Luther Hurd (M. '30), retired officer manager of the track division of the New York City Board of Transportation, died in White Plains, N.Y., on November 4. He was 67. Previously, Mr. Hurd had been assistant engineer of the New York City Board of Water Supply. He retired as office manager of the Board of Transportation in 1941.

Harvey Julius Kulin (Assoc. M. '47), consulting engineer and junior partner in the engineering firm of Couch & Kulin, Indianapolis, Ind., died there on October 21, at the age of 39. Mr. Kulin was associated with the Fairbanks-Morse Co., Chicago, Ill., the Chicago Pump Co., and the American Well Works, of Aurora, Ill., before entering the Army as a captain during World War II. In 1946 he became district engineer of Infilco Inc., with headquarters in Chicago. He was a graduate of the University of Illinois.

Edward Joseph Kelly (M. '19), consulting engineer and former mayor of Chicago, died in that city on October 20 at the age of 74. Identified with the Sanitary District of Chicago from 1894 to 1933, Mr. Kelly filled every post from axman to chief engineer. During this period he was loaned to the state for work as Illinois Water Commissioner. Later during his long tenure as mayor (1933 to 1947), he launched the city's $40,000,000 subway program and its $100,000,000 superhighway program. Since his retirement from public office in 1947 he had maintained a consulting practice. Mr. Kelly had been vice-president and president of the U.S. Conference of Mayors and a member of the Western Society of Engineers.

Edward J. Kelly

George Wilfrid McCordic (M. '40), since 1942 engineer-director of the Huron-Clinton Metropolitan Authority, Detroit, Mich., died on October 26, at the age of 51. Upon his graduation from the University of Michigan in 1922, Mr. McCordic entered the employ of the engineering firm of Hubbell, Hartgering & Roth, of Detroit, where he remained until the formation of McCordic, Stadler & Larsen in 1929. He became chief engineer for the State of Michigan in 1933.

Peter Mogensen (M. '07), retired civil engineer of Urbana, Ill., died there on October 22. He was 89. For a number of years Mr. Mogensen was engineer of tests in the engineering department of King County, Washington, and established a laboratory in the Seattle County-City building. During World War I he was engaged by the War Industries Board. As a consultant, he worked on the design of a large number of bridges, canals, railroads, and hydroelectric plants in the United States, Canada, and Mexico. He was a graduate of the University of Illinois, class of 1894.

Frederick David Richards (M. '11), for more than 50 years an architect and engineer in Cleveland, Ohio, died on October 15, at the age of 82. He was city bridge engineer for 20 years and since 1920 had been a partner in the firm of Carter & Richards. He was a civil engineering graduate of the Case School of Applied Sciences.

Stewart Fisher Robertson (Assoc. M. '44), partner in the engineering firm of Whitman, Requardt & Associates, Baltimore, Md., died on October 23. He was 45. Prior

(Continued on page 76)

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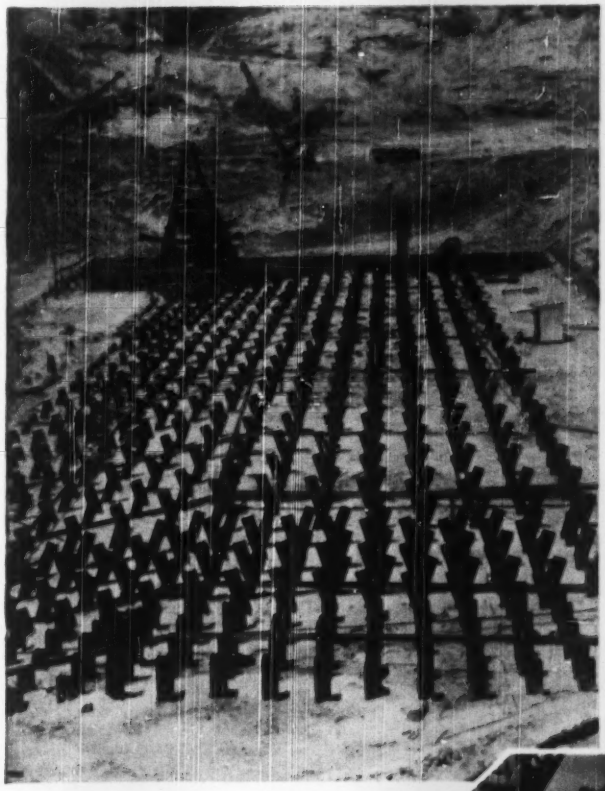
Steel H-Beam Bearing Piles support huge spillway for Dam "B" near Jasper, Texas



DAM "B" is located on the Neches River, near Jasper, in the piney hills of East Texas. As a unit of the four-dam Neches-Angelina Rivers project, Dam "B" will provide a reservoir which will regulate the fluctuating outflows from the power plants of the proposed McGee Bend and Rockland reservoir projects.

Construction of the concrete spillway section necessitated re-routing of the Neches River, excavation of 225,000 cubic yards of material and construction of a foundation of 53-pound steel H-Beam bearing piles.

These U·S·S Bearing Piles, CBP Section-124, are spaced at 5-foot centers in the spillway structure, at 3½ foot centers in the wing walls, and at 8-foot centers in the stilling basin area, driven into hard packed clay with a 19,000 foot-pound hammer.

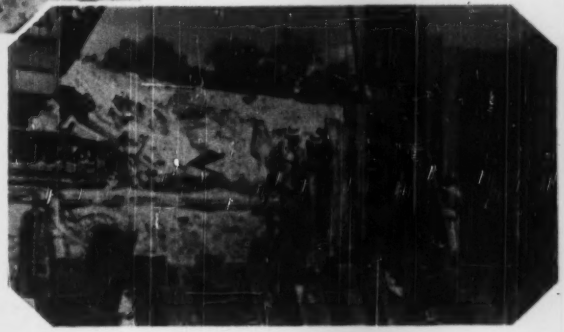
The gates of Dam "B" will close in December of 1950, with the entire project expected to be completed in 1952.

This dam foundation is one of many nationally important foundation jobs in which both economical and practical considerations are better served by U·S·S Steel Bearing Piles and U·S·S Steel Sheet Piling. Let us show you how these service-tested construction products can be used to solve your problems most efficiently. For complete details, call the United States Steel office nearest you, or write to United States Steel, 2135 Carnegie Building, Pittsburgh 30, Pennsylvania.

(Above) Piling in the main part of the structure consists of alternate rows of batter piling, up-stream and down-stream three-to-one, to sustain lateral load and prevent sliding. Straight vertical pilings are used in the stilling basin.

(At right) Driving sections of U·S·S MP-102 Steel Sheet Piling along the up- and down-stream limits of the concrete spillway structure to prevent seepage under the concrete portion of the dam. The up-stream sections are 32 feet long, down-stream, 26 feet long.

Construction is under the direction of Lt. Colonel Ellsworth I. Davis, District Engineer, U. S. Army Corps of Engineers, Galveston, and under the immediate supervision of Fred W. Johnson, Resident Engineer. The gated spillway will be built by Reynolds & Williams and Noonan Construction Company, G. E. Murphey, Superintendent.



USS

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH · COLUMBIA STEEL COMPANY, SAN FRANCISCO
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UNITED STATES STEEL

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Men Available

CIVIL ENGINEER. Assoc. M. ASCE; licensed professional engineer; licensed airplane pilot; 5 years design experience ending as assistant chief; 6 years construction experience ending as chief employed as construction planning engineer. Desires position with architectural engineer or construction firm either stateside or foreign. C-633

CIVIL ENGINEER. Assoc. M. ASCE; 36; geotechnic engineer, registered Pennsylvania; 5 years hydraulic and general planning experience; 4½ years general construction and contract administration; 2 years engineering studies and report writing; last 2½ years and present engineering investigations and reports, preparation of plans and specifications, and contract administration; responsible charge past 11 years. Desires position with consulting firm with possibility of partnership or small construction company on bonus basis. C-634

CIVIL ENGINEER. Jun. M. ASCE; 27; B.S. in C.E., June 1947; married; 1 year as assistant engineer on land acquisition; 2 years as construction engineer. Desires position as construction engineer. Will locate anywhere. C-635

CIVIL ENGINEER; Jun. M. ASCE; 26; married; veteran; B.S. in C.E., 1948, Cornell University; 2½ years field and office engineering for contractor specializing in heavy construction. Desires permanent employment with engineering or construction firm. Location optional. C-636

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

PROFESSOR, CIVIL ENGINEERING; Assoc. M. ASCE; 40; Ph.D. Now occupying teaching position in leading university. Responsible academic and governmental engineering experience. Interested in post involving administrative and executive opportunities such as department head. Excellent health. Minimum salary desired $7,500. C-637.752CE

MANAGING ENGINEER; M. ASCE; licensed professional engineer, New York State; over 25 years in building construction, commercial and institutional; experience in negotiating subcontracts, controlling costs, supervising estimates; capable of good relations with clients in conference or through correspondence. C-638

CIVIL ENGINEER; Jun. M. ASCE; 25; married; veteran; 1½ years' experience in highway field work; desires position which offers design experience; eastern United States preferred. C-639

CIVIL ENGINEER; Jun. M. ASCE; B.C.E. Cornell University; New Jersey in-training license; 25; veteran; 2½ years drafting, design and field experience in highway engineering field; desires position with promising future in New York, New Jersey, or eastern Pennsylvania. C-640

ENGINEER; Jun. M. ASCE; civil and sanitary degree; 37; single; ex-Naval aviator; valid pilot's license; experience in building estimating, design, job layout, aerial surveys, also advertising and sales experience. Speaks Slavic; will travel in United States or Europe. C-641

CIVIL ENGINEER, Assoc. M. ASCE; 31; married; licensed in New Jersey; 9 years varied office and field experience in dredging, bridge construction, water supply, gas pipeline, highway and various small buildings; desires position as assistant resident engineer in or near New Jersey. C-642

WANTED BY AN ELECTRIC UTILITY ENGINEERING SERVICE CORPORATION LOCATED IN NEW YORK CITY

Structural Designer of 5 to 10 years' responsible experience on design work including steel building structures, reinforced concrete structures. Some architectural experience is desirable. Good opportunity for advancement.

Box C. E. 191

CIVIL ENGINEERING
33 West 39th St.
New York 18, N. Y.

WANTED BY AN ELECTRIC UTILITY ENGINEERING SERVICE CORPORATION LOCATED IN NEW YORK CITY

Hydraulic-Foundation Designer of 5 to 10 years' responsible experience on design work including mass and reinforced concrete structures, dams, building foundations and other hydraulic structures. Good opportunity for advancement.

Box C. E. 192

CIVIL ENGINEERING
33 West 39th St.
New York 18, N. Y.

STRUCTURAL DESIGNER WANTED

C. E. graduate major in structural design with 3 to 5 years' experience in design of steel and reinforced concrete structures and in general drafting room procedure. Experience in structural design in oil refinery or chemical industry desired. Location Chicago.

Box C. E. 193
Civil Engineering
33 W. 39th Street
New York 18, N. Y.

Positions Available

SALES ENGINEER, young, civil graduate, with municipal engineering and heavy construction experience, to sell cast iron pipe, fittings, etc., to municipalities, contractors, and general industrials. Must be resident in territory. Salary, $3,000-$3,600 a year. Location, New England. Y-4319.

DESIGN ENGINEER, experience in structural and mechanical design and able to make layouts and engineering drawings, to work on the planning and design of a large crushing plant and conveyor system. Salary, $4,800-$6,000 a year. Location, Colorado. Y-4347.

ENGINEERS. (a) Chief Bridge Engineer, 30-50, with at least 10 years' highway bridge experience, to supervise engineering staff of consulting firm. Salary, $8,000-$10,000 a year plus bonus. (b) Design Engineer with general highway and bridge experience, including traffic interchange, clover leaf access points, etc., to do planning, design, and layout of highway structures and roads. Salary, $4,250-$5,400 a year with bonus. Location, West Virginia. Y-4351.

DESIGN DRAFTSMAN, young, civil or architectural graduate, with industrial building experience, to design and lay out small warehouses, stucco buildings, driveways, etc. Salary, $3,600-$3,900 a year. Location, Albany, N. Y. Y-4370.

PLANT ENGINEER, 30-45, mechanical or civil graduate, for large steel mill. Must be familiar with general engineering problems pertaining to new construction, maintenance of machinery and equipment, installation of new machinery, analyses of new machine requirements, machinery and equipment layout changes and machine design. Should have about 5 or more years' experience in the above field. Salary, $5,400 a year. Location, West Virginia. Y-4401.

ENGINEERS. (a) Design Engineers, structural with some experience in concrete and steel for large hydroelectric project. (c) Architectural Engineer with some public utility building experience. Salaries open. Location, Portland, Oreg. Y-4424S.

ENGINEERS. (a) Construction Engineer with considerable experience, who has had complete charge of the construction of high straight gravity dams with large sized tunnels and power houses. (b) Construction Superintendent-in-Charge with respect to the tunnels to be built in conjunction with this dam. The dam to be constructed will be a 680 ft high straight gravity dam with large tunnels and powerhouses. Duration, 5 years. Salary open, including furnished living quarters. Location, India. Y-4461CDS.

DRAFTSMAN, mechanical engineer or civil engineer, about 30, good experience in general plant engineering drafting, able to deal with simple structural calculations and lay out. Will train and prove for engineering job. Salary, $4,980-$5,760 a year. Location, Wisconsin. R-6991.

CITY ENGINEER, graduate. Qualified to plan and supervise municipal projects and deal with the public for a city of nearly 12,000. Salary open. Location, Montana. R-7018.

STRUCTURAL ENGINEER, office crew leader, civil engineering degree, about 40, with at least 15 years' experience on industrial type construction, knowledge of engineering, plans, construction, materials on foundations, concrete, steel, aggregates, etc. Able to act as engineering office representative, deal with owners, architects and sub-contractors, and/or prepare reports and treat with revisions, alterations and changes. Duration, 9 months to 1 year. Salary, $7,800 a year. Location, Arkansas. R-7056.

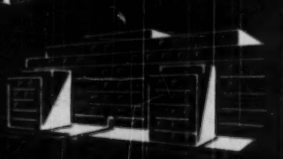
Positions Announced

Fifth Naval District. The Public Works Office of the Fifth Naval District is seeking applicants for the following positions: General Engineer, GS-9; Structural Engineer, GS-9; Civil Engineer, GS-9; and Engineer (Specification Writer), GS-9. All carry initial salaries of $4,600 per annum. Inquiries should be addressed to the Public Works Office, Fifth Naval District, Norfolk 11, Va.

M-C & S stands for—
Many Construction Skills

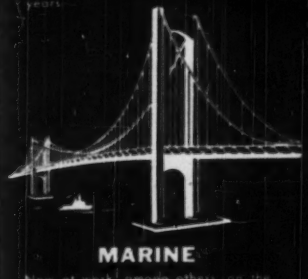
INDUSTRIAL

Whatever your project, it will not be out of our line. For Merritt Chapman & Scott's vast experience is based on a broad range of construction assignments. In the pulp and paper industry, for example, M C & S has put its specialized skills to work building new plants or additions for 12 companies within the past 10 years.



BUILDING

Merritt-Chapman & Scott's ability to produce the highest quality work on time is evidenced by the fact that it has completed more than [illegible] hospital facilities. M C & S has just completed two projects for the Veterans Administration and is now constructing a new VA hospital at West Haven, Conn.



MARINE

Now at work among others on the substructure for the 4.3 mile long Chesapeake Bay Bridge, M C & S's diverse construction skills have helped build many of America's major bridges. Recent projects include the Mystic River Bridge, Boston, the Mississippi River Bridge at Memphis and the Delaware Memorial Bridge near Wilmington, Del. for which M C & S constructed the largest caisson of its type ever built.

HEAVY

Tunnel construction calls for a combination of heavy muscle and needle point precision. It demands absolute mastery of every building skill. M C & S has built three of the nine Harbor type tunnels in the United States and is at work on a fourth. And bridge piers M C & S is equally well known. Latest such project is the new Mystic Pier terminal, Boston.

MERRITT-CHAPMAN & SCOTT
CORPORATION
Founded in 1860 . . . now in our 90th year
General Offices
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CLEVELAND · BOSTON · NEW LONDON

Deceased

(*Continued from page 72*)

to Mr. Robertson's connection with the firm in 1937, he was with the Roland Park Co., and had served as an instructor at Baltimore Polytechnic Institute. He was educated at Baltimore Polytechnic Institute and Johns Hopkins University.

Spencer Gray Scoular (M. '45) for the past twelve years city and drainage engineer for the Dunedin Drainage & Sewerage Board, Dunedin, N.Z., died on October 22, at the age of 54. He was a University of New Zealand graduate. During the first World War he served with expeditionary forces in Egypt, Persia, and France. Later he was assistant for the Dunedin City Council, principal assistant city engineer and acting deputy engineer. In 1938 he became city and drainage engineer.

Henry Anthony Strecker, Jr. (M. '48) consulting engineer of Freeport, N.Y., died recently. His age was 48. In 1921 Mr. Strecker became connected with the Pennsylvania State Department of Public Works, serving in Philadelphia, Allentown, and Erie. He had also been connected with Johnson, Drake & Piper, at Freeport, N.Y., Jones & Loughlin Steel Corp., at Woodlawn, Pa., the Pennsylvania Railroad, and several municipalities.

William Randall Tompson (Assoc. M. '39) former superintendent of highways in Wakefield and Belmont, Mass., died in Wakefield on September 27. He was 67. For 30 years Mr. Tompson served as superintendent of highways. He was a past-president of the Massachusetts Highway Association. He received his engineering training at Tufts College.

Arthur Ellsworth Winslow (Assoc. M. '06) retired dean emeritus in the engineering department of Norwich University, died in Northfield, Vt., on October 17. His age was 73. Before Professor Winslow became dean at the University in 1933, he served as head of the civil engineering department for 33 years. He graduated from Norwich University in 1898. At commencement exercises last June, Dean Winslow received the honorary Doctor of Science degree.

Roscoe Cyprian Young (M. '02) since 1937 consulting engineer for the Lake Superior & Ishpeming Railroad Co., Marquette, Mich., died there on October 4, at the age of 75. Prior to 1937 he acted as chief engineer for several railroads on the design of bridges, docks, and terminals.

NEWS OF Engineers

Gordon H. Butler, ASCE Director for District 7 and president of the Polaris Concrete Products Co., Duluth, for over 30 years, was elected to the Minnesota State Senate in the recent November elections. Called to active duty as major of Engineers in 1941, Mr. Butler was in charge of the construction of a $22,000,000 anhydrous ammonia plant in this country, and later served abroad in both theaters of war. He is a past-president of the Duluth Section of the Society, the Duluth Engineers Club, and the Minnesota Federated Engineering Societies.

Gordon H. Butler

Eldon C. Frye is now public health engineer for the Mesa County (Colorado) Health Department, at Grand Junction. For the past three years Mr. Frye has been associated with the Weld County and the San Juan Basin health departments.

Capt. John P. Agnew, Jr., formerly assistant resident engineer for the Corps of Engineers' Allatoona Dam project near Cartersville, Ga., has been appointed executive officer of the Mobile, Ala., District of the Corps.

Clifford S. Strike, president of F. H. McGraw & Co., engineers and constructors of Hartford, Conn., announces that the firm's Western office is now located in the Wasatch Oil Building, Salt Lake City, Utah.

J. Bres Eustis announces the merger of his office with that of **Charles A. Bragg** under the firm name of Eustis Engineering Co., with headquarters at 3645 Airline Highway, New Orleans 20, La.

James Girand has been elected vice-president of the New York Water Service Corp., New York City. Formerly he held the position of assistant to the president.

Francis S. Friel, ASCE Director and president of the Philadelphia firm of Albright & Friel, was given the fourth annual Drexel Alumni Association Award on October 7 at the homecoming dinner in Philadelphia. The award is given for efforts on behalf of Drexel or the alumni association. Mr. Friel is a member of Drexel's board of trustees.

Troy Carmichael, previously engineering director of the New Jersey Bituminous Concrete Association, is now state highway engineer of Montana, at Helena.

Roy. N. Brodie, who has been serving as assistant structural engineer of the Boston & Maine Railroad, Boston, Mass., has become engineer of structures, succeeding **Benjamin W. Guppy,** who has retired after 61 years of service.

J. O. Adams, materials engineer for the Kansas State Highway Commission at Chanute, has been called to active duty with the 835th Engineer Aviation Battalion.

B. C. Fowlkes, Jr., for the past year and a half, district engineer for the Vicksburg, Miss., District of the Corps of Engineers, has been assigned to the Engineer Depot at Granite City, Ill. Colonel Fowlkes will be succeeded by **Lt. Col. George F. Dixon, Jr.,** who has been executive officer and assistant district engineer. His title will be acting district engineer. **Capt. Walter R. Hylander** has been named to the post of assistant district engineer.

B. C. Fowlkes, Jr.

George F. Dixon, Jr.

Edward J. Cleary, executive director of the Ohio River Valley Water Sanitation Commission, has been unanimously elected U.S. director of the Board of Directors for the Inter-American Association of Sanitary Engineering for the term, 1950–1953.

Robert F. Coleman, Jr., acting city engineer of Wilmington, N.C., since April of this year, has been named city engineer.

Louis H. Oppenheim has been named assistant general manager of Kaiser Engineers, division of Kaiser Industries, Inc., Oakland, Calif. He will also continue to serve as assistant chief engineer of Kaiser Engineers. Mr. Oppenheim joined the organization in 1938 as plant engineer of the Radum plant and subsequently acted as assistant to the chief engineer and assistant chief engineer of the iron and steel division during the design and construction of the Fontana plant.

L. H. Oppenheim

Charles E. Downe, formerly planning director of the City Plan Department of New Haven, Conn., has accepted a similar post with the City of Worcester, Mass.

Fred W. Haselwood has retired from the California Division of Highways, Sacramento, after 38 years of service, to open a consulting office in Redding, Calif. Mr. Haselwood spent 26 years as district engineer in the three northern districts of the state.

Hans H. Bleich, since 1946 lecturer in civil engineering at Columbia University, has been named associate professor. Dr. Bleich is engaged in the completion of a research project on "The Buckling Strength of Metal Structures," that is sponsored by the U.S. Navy in cooperation with the Column Research Council. For the past five years he has been associated with Hardesty & Hanover, New York City consultants.

(*Continued on page 78*)

Are you "missing a bet" on Foundation Jobs?

More and more contractors are discovering they can profitably handle many foundation jobs with the aid of Armco Steel Pipe Piles.

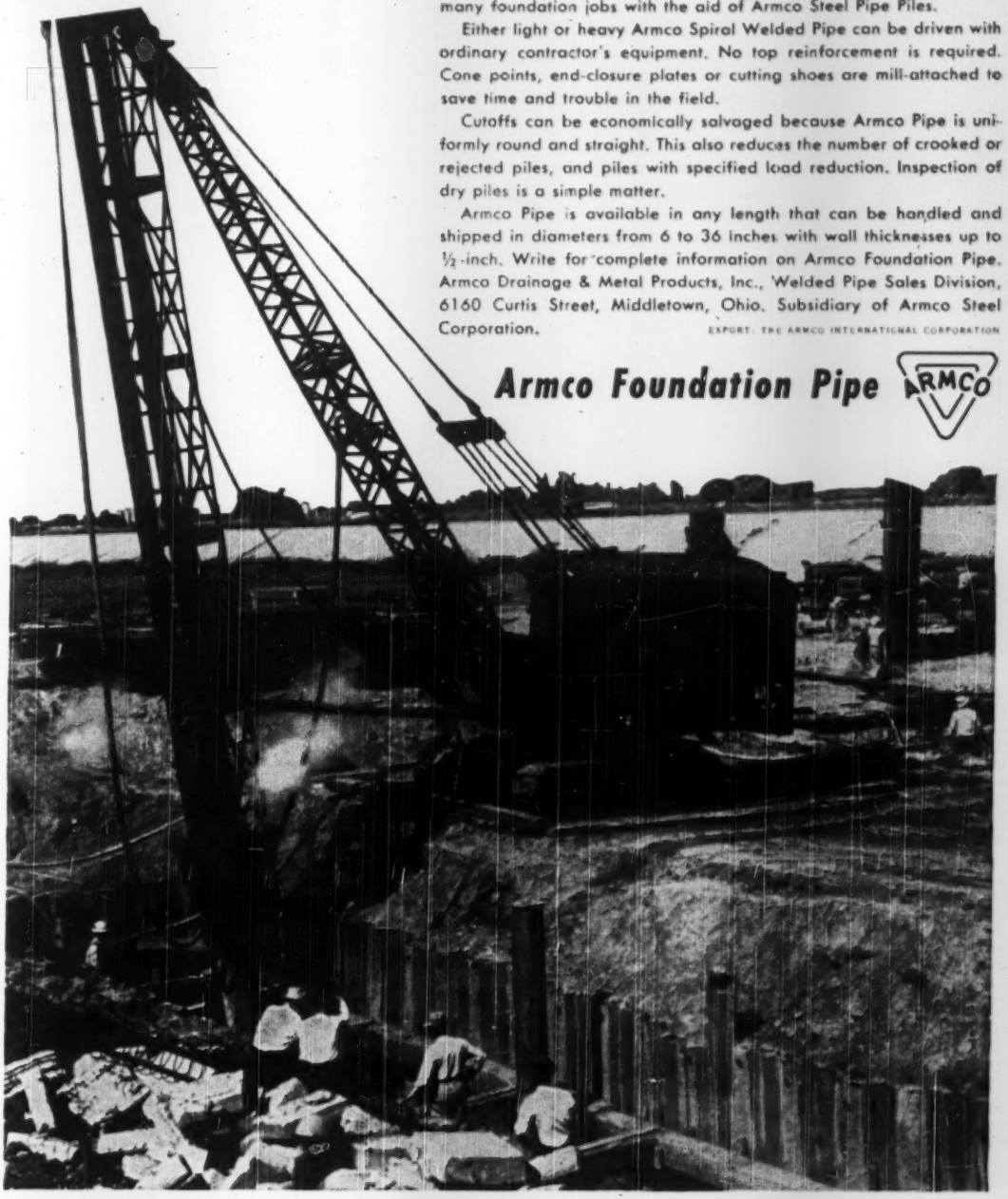
Either light or heavy Armco Spiral Welded Pipe can be driven with ordinary contractor's equipment. No top reinforcement is required. Cone points, end-closure plates or cutting shoes are mill-attached to save time and trouble in the field.

Cutoffs can be economically salvaged because Armco Pipe is uniformly round and straight. This also reduces the number of crooked or rejected piles, and piles with specified load reduction. Inspection of dry piles is a simple matter.

Armco Pipe is available in any length that can be handled and shipped in diameters from 6 to 36 inches with wall thicknesses up to ½-inch. Write for complete information on Armco Foundation Pipe. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 6160 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

Armco Foundation Pipe ARMCO



News of Engineers

(Continued from page 76)

Carleton E. Davis, consulting engineer for the Philadelphia Suburban Water Co., has been named winner of the 1950 George Warren Fuller Award for planning, construction, and operation of water plants. Mr. Davis has been engaged in water supply development for 50 years, and was chief of the Philadelphia Bureau of Water from 1913 to 1923.

ASCE Past-President J. C. Stevens, partner in the consulting firm of Stevens & Koon, Portland, Oreg., has been honored by the University of Portland as one of the six leaders who has aided in the development of the Pacific Northwest in the past 50 years. Mr. Stevens is cited for his work as a consultant on the many large irrigation and reclamation projects in that area, and for his inventions of engineering instruments.

J. C. Stevens

Fred L. Plummer, director of engineering, Hammond Iron Works, Warren, Pa., has been elected second vice-president of the American Welding Society for 1950-1951.

W. H. Ogan, for the past two years with the construction department of the Kansas State Highway Commission, at Great Bend, has been promoted to resident engineer of the commission at Winfield.

Pecos H. Calahan, executive secretary of the California State Board of Registration for Civil and Professional Engineers, Sacramento, since 1929, has retired. For many years Mr. Calahan engaged in private practice in southern California.

Henry C. Helland, chief engineer of Canyon Constructors, Helena, Mont., has become control engineer for the Montana Highway Department at Helena. His duties will include responsibility for projects from the planning to the construction stage. He is a past-president of the Montana Section of the Society.

Earl Withycombe, who has been serving as construction engineer for the California Division of Highways at Sacramento, and **Charles E. Waite,** who has been acting as district engineer for the Division of Highways, at Stockton, have been appointed assistant state highway engineers with headquarters at Sacramento.

James F. Smythe, formerly assistant to the head of design and construction for Ebasco Services, Inc., New York City, has accepted the position of contracting engineer with Wigton-Abbott Corp., engineers and contractors of Plainfield, N.J.

Clarence C. Davis, previously staff engineer for the New England Military District of the Corps of Engineers, has become resident engineer at Detroit Dam on the North Santiam River in western Oregon.

Bertram H. Lindman, who has been a consulting engineer for the Association of American Railroads, is now associated with Transportation Consultants Inc., in their Washington, D.C., office.

Louis A. Molnar, formerly project engineer for the Ralph M. Parsons Co., of Los Angeles, Calif., is now associated with the American Architect-Engineers, Inc., of Los Angeles, Calif., and Albuquerque, N. Mex. Mr. Molnar will have charge of the civil and structural engineering departments.

James P. Growden, chief hydraulic engineer for the Aluminum Company of America, Pittsburgh, Pa., was recently awarded the Legion of Merit by the Department of the Army for "exceptional meritorious conduct in the performance of outstanding services during World War II."

Harold V. Gulick has been promoted to chief construction engineer for the American Locomotive Co., Schenectady, N.Y., and will be responsible for expansion and maintenance of the company's plants at Schenectady, Auburn, and Dunkirk, N.Y., Latrobe, Pa., and Chicago, Ill. Mr. Gulick is past-president of the Mohawk-Hudson Section and Contact Member for the Union College Student Chapter.

Carroll T. Newton, lieutenant colonel, Department of the Army, has been named chief of the Plans Division, Office of Assistant Chief of Staff, G-4 (Supply), of the Japan Logistical Command, with headquarters in Yokohama. Prior to this assignment, Colonel Newton performed similar duties in the headquarters of the Eighth Army in Japan.

John A. Focht, formerly professor of highway engineering at the University of Texas, has been appointed assistant dean of the college of engineering there.

REAR ADMIRAL I. F. JELLEY, CEC, USN, chief of Bureau of Yards and Docks, Washington, D.C. (left), presents first Annual Award of Chief of Bureau of Yards and Docks to John I. Healy, lieutenant (j.g.), CEC, USN, of Azusa, Calif., for his essay on "Wave Damping Effects of Beaches." Lt. Cushing Phillips, CEC, USN, attached to Naval Auxiliary Air Station, Monterey, Calif., won Honorable Mention for paper entitled, "The Development of Low-Cost Paving and Paving Maintenance at NAAS, Monterey, Calif." The Award, established in 1949 by Association of Civil Engineers, United States Navy, is given annually to officer of CEC who submits best paper on any subject within scope of Bureau activities.

E. M. Hastings, Past-President of ASCE, has retired as chief engineer of the Richmond, Fredericksburg & Potomac Railroad, Richmond, Va., after nearly 47 years of service. Mr. Hastings served the Society as Vice-President in 1943 and 1944, and as President in 1947, and for many years as Contact Member for the Virginia Military Institute. He will be succeeded by **James C. DeJarnette** as chief engineer of the railroad.

E. M. Hastings

W. P. Jones, Jr., is the new officer-in-charge of the San Antonio, Tex., suboffice of the Corps of Engineers. Prior to this assignment, Colonel Jones served as executive officer of the Personnel Division in the Chief Engineer's Office in Washington.

John W. Graham, Jr., assistant to the dean of the college of engineering and sciences and assistant professor of civil engineering at Carnegie Institute of Technology, has been named president of the Pittsburgh chapter of the Pennsylvania Society of Professional Engineers.

David B. Lee, chief sanitary engineer and director of the Bureau of Sanitary Engineering, Florida State Board of Health, Jacksonville, was honored by unanimous election to the presidency of the Florida Public Health Association at its recent annual meeting in St. Petersburg, in recognition of his outstanding achievements in the sanitary engineering and public health fields.

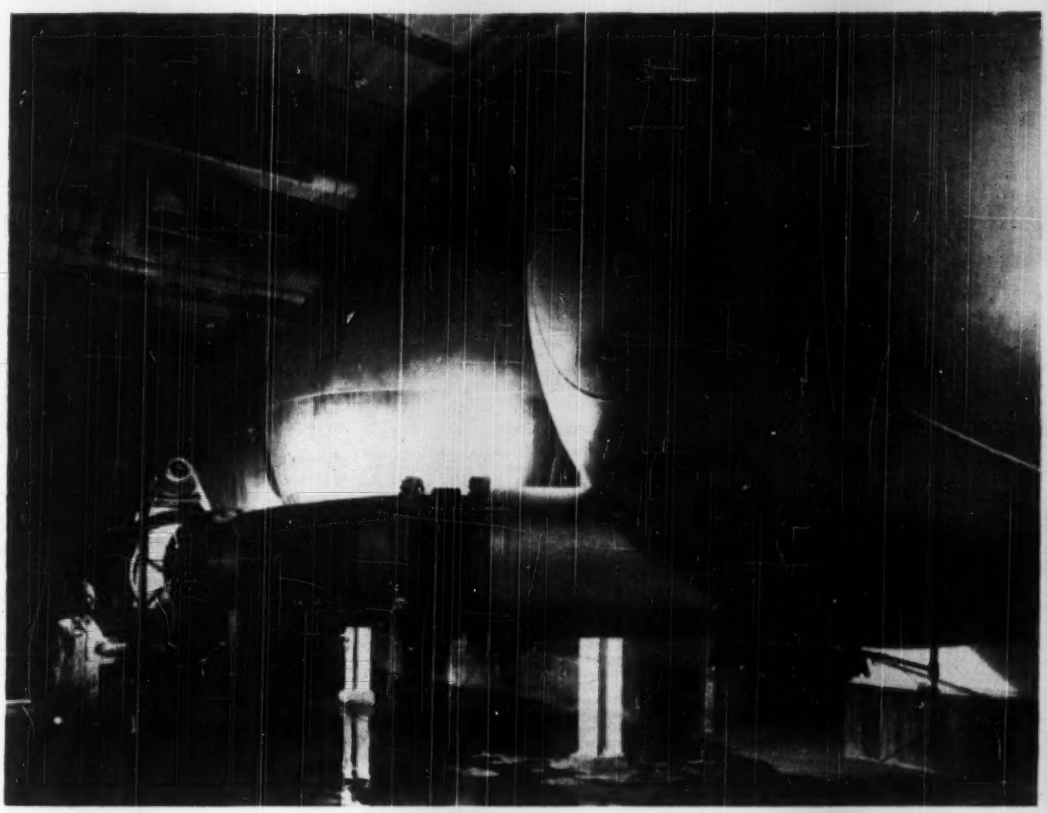
George R. Halton and **Ray O. Maurseth** announce that their services as engineering consultants in soils and foundations, highways, airports, tanks, structures, and buildings, will be available at 1060 Broad Street, Newark, N.J., and at 4508 Crenshaw Blvd., Los Angeles, Calif., respectively.

Fred M. Sloane, division engineer in the Milwaukee Terminal of the Madison and Superior Divisions of the Chicago, Milwaukee & St. Paul Railroad since 1932, has retired. Mr. Sloane entered the employ of the railroad in 1907.

Francis M. Warnick, area engineer for the Bureau of Reclamation at Salt Lake City, Utah, and **Earl S. Jensen,** engineer in the same office, have been named project development engineer and office engineer on the Weber Basin project in Utah, respectively.

John G. Hoad, formerly with the Detroit Edison Co., Detroit, Mich., has become connected with the firm of Cummins & Barnard, of Ann Arbor, Mich.

Robert V. Smrha, since 1937 assistant chief engineer of the Water Resources Division of the Kansas State Board of Agriculture, Topeka, will become chief engineer of the division on January 1, 1951, succeeding **George S. Knapp,** long-time chief engineer who has asked to be relieved of administrative responsibilities. Mr. Knapp will be retained as a consultant on a part-time basis.



Horton Tanks Help Solve an Old Riddle

The eighty-year-old problem of recovering process chemicals and using the organic materials dissolved out from the wood chips in the sulphite pulping process, is at last being solved. And what's more, the solution may also mean the end of stream pollution.

In the new Weyerhaeuser Timber Company's plant at Longview, Washington, years of research on the problem are being put into practice. A sulphite recovery process has been developed to recover chemicals from liquors used in production of sulphite pulp, and to produce electrical energy and steam from organic materials in the liquors.

Looking like something from Mars are the four welded steel dump chests, shown above, that are used in this process. These balloon-like structures were fabricated and erected by the Chicago Bridge and Iron Company to receive pulp coming from the digesters. Inside, they are protected by acid-resisting linings. Each of the four 16-ft. diam. by 71-ft. chests is supported by two ring girders spaced 37 feet apart. The base of one girder on each vessel is fixed, the other moves as the shell expands and contracts. Each tank also has a 40-in. pipe connection attached to both sides, and one 8-in. and one 20-in. nozzle at the top.

These dump chests are another example of the specialized steel plate work we are doing for industry. We also fabricate: Sulphate digesters . . . Sulphite digesters . . . Diffusers . . . Accumulators . . . Marx Savealls . . . Acid tanks . . . Pulp tanks . . . Storage tanks . . . Elevated water tanks . . . Settling tanks.

Write our nearest office for estimates the next time you need steel plate structures of any type.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3	2167 Healey Bldg.	Detroit 26	1541 Lafayette Bldg.	Philadelphia 3	1652—1700 Walnut St. Bldg.
Birmingham 1	1596 N. Fiftieth St.	Havana	402 Abreu Bldg.	Salt Lake City 4	509 West 17th South St.
Boston 10	1009—201 Devonshire St.	Houston 2	2128 National Standard Bldg.	San Francisco 4	1584—200 Bush St.
Chicago 4	2199 McCormick Bldg.	Los Angeles 14	1556 General Petroleum Bldg.	Seattle 1	1309 Henry Bldg.
Cleveland 15	2263 Guildhall Bldg.	New York 6	3395—165 Broadway Bldg.	Tulsa 3	1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

A.S.T.M. Standards

Standard and tentative specifications, test methods, and definitions of terms have been made available by A.S.T.M. Committees C-9 and D-4, April 1950. These are grouped under the following bound classifications: mineral aggregates; concrete; brick and block pavement materials; concrete curing materials and expansion joint fillers; cement and miscellaneous items. A numerical list of standards is included. (240 pages, illustrations, $2.25. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.)

Die Vereinfachte Trägerrostberechnung

Detailed theoretical treatment of girders connected by rigid cross beams, practical applications of various equations, models, tables, and results of experiments are included by the authors, F. Leonhardt and W. Andrä, to aid the designer and engineer concerned with structures using these principles. The book, published by Verlag Julius Hoffmann, Stuttgart, Germany, 1950, may be obtained in New York at Steichert Hafner for $8. It is illustrated and contains 230 pages.

(The) Effects of Atomic Weapons

Prepared for and in cooperation with the U.S. Department of Defense and the U.S. Atomic Energy Commission under the direction of the Los Alamos Scientific Laboratory, this book summarizes present knowledge about the effect of atomic explosions. The nature of the explosion and its blast and radiation effects on people and property are considered in detail. Nuclear radiation measurement, decontamination, and protection of personnel are also among the topics discussed. (Published by McGraw-Hill Book Co., New York, Toronto and London, 1950. 456 pages and illustrations. $3.)

Heat Insulation

Miscellaneous information on heat insulation has been brought together in one volume by the author, G. B. Wilkes. In addition to the material on the fundamental formulas types, purposes and economics of insulation and insulating materials, there are special chapters on reflective insulation, methods of determining heat transfer coefficients, factors affecting the coefficient of thermal conductivity, and a bibliography. (Published by John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1950. 224 pages, illustrations. $4.)

House Construction Costs

Necessary information for making intelligent cost estimates on each division of house construction is provided for contractors, carpenters and home builders by the author, G. Underwood. Illustrations of structural details and full, detailed descriptions of building operations are given in this 314-page book, published by McGraw-Hill Book Co. (New York, Toronto, London.) 1950, and sold for $4.50.

Industrial Organization and Management

This second edition is designed to provide a full and detailed understanding of the specialized activities of industrial organizations, large or small, their interrelationships, and the guiding principles used by management to coordinate and control them. New sections are included by the authors, L. L. Bethel, F. S. Atwater, G. H. E. Smith and H. A. Stackman, Jr., on production processes, waste control, plant and equipment maintenance, equipment replacement, and other matters dealing with principles of cost reduction. (McGraw-Hill Book Co., New York, Toronto, London, 1950. 851 pages, illustrations. $5.50.)

Irrigation Principles and Practices

Features of the second edition of *Irrigation Principles and Practices* by O. W. Israelsen are a simplified treatment of the flow of water in soil, new material on drainage, a consideration of the consumptive use of water, and a discussion of the social and administrative aspects of irrigation. Irrigation principles are particularly stressed. More than 300 selected references to recent publications on irrigation and drainage are also included. (John Wiley & Sons, New York, and Chapman & Hall Ltd., London, 1950. 405 pages. $6.)

Policies on Geometric Highway Design

Seven policies formulated, approved, and published by the American Association of State Highway Officials are presented in *Policies on Geometric Highway Design*. They cover highway classification, highway types, sight distance for highways, criteria for marking and signing no-passing zones for two and three-lane roads, intersections at grade, rotary intersections, grade separations for intersecting highways, and design standards for interstate, primary, and secondary systems. (American Association of State Highway Officials, 1220 National Press Bldg., Washington, D.C., 1950. $3.25.)

Procedures for Testing Soils

A compilation of some 90 standards and suggested methods for soil and soil mixtures is offered under the title *Procedures for Testing Soils* by the ASTM Committee D-18 on Soils for Engineering Purposes. There are five main sections: Explorations and sampling; special and construction control tests; and bearing tests in place and dynamic properties. There is an explanatory foreword for each section in addition to a general introduction and a glossary of terms and symbols relating to soil mechanics. (Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1950, 418 pages. $3.75.)

Refresher Notes for Professional Engineers License Examination

Of interest to those preparing for Professional Engineers License Examinations, this volume contains condensed basic information problems and their solutions from the field of hydraulics, thermodynamics and machine design. In this third edition of *Refresher Notes for Professional Engineers License Examination*, J. D. Constance has added 30 pages of problems and a new chart on four-bar linkages. (John D. Constance, 625 Hudson Terrace, Cliffside Park, N.J., 1950. $1.50.)

Structural Theory

Emphasizing structural stress analysis, *Structural Theory* serves as an introduction to the basic concepts relating to trusses, rigid frames, and space frames. The authors, H. Sutherland and H. L. Bowman, have made major revisions in this fourth edition in the chapters dealing with slope and deflection, and with rigid frames. New material is included on the solution of compound trusses by means of the Willicot-Mohr diagram, fixed points in continuous beams, on members of varying moment of inertia, and the treatment of the Morris Method is expanded. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1950. 394 pages. $5.)

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ASCE MEMBERSHIP AS OF NOVEMBER 9, 1950

Members	7,749
Associate Members	9,947
Junior Members	12,849
Affiliates	68
Honorary Members	39
Fellows	1
Total	30,653
(November 9, 1949	27,237)

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New Publications

Geologic Survey. In addition to a detailed description of geologic formations of Carroll County, Mississippi, Bulletin 67 of the State Geologic Survey deals briefly with climate, physiographic features, structural geology, geologic history, and economic geology. A map of the area and 24 illustrations are also included. Inquiries should be addressed to the Office of the State Geological Survey, University, Miss.

Texas Roster. The State Board of Registration for Professional Engineers has made its annual roster for 1950 available under the title *Registered Professional Engineers*. Address all inquiries to the Texas Engineers' Library, A & M College, College Station, Tex.

Water Resources. To aid in the formulation of acceptable principles and procedures for determining benefits and costs of water-resources projects, the Subcommittee on Benefits and Costs of the Federal Inter-Agency River Basin Committee has prepared a report entitled *Proposed Practices for Economic Analysis of River Basin Projects*. A limited number of copies is available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 25 cents each.

Highway Research. Bulletin No. 25 of the Highway Research Board studies the relief of traffic congestion through *Controlled Access Expressways in Urban Areas*. The report is available for 60 cents from the Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington 25, D.C.

Sedimentation. As a guide to the literature on engineering aspects of sedimentation, the U. S. Soil Conservation Service in cooperation with the agencies represented on the Subcommittee on Sedimentation of the Federal Inter-Agency River Basin Committee has prepared an *Annotated Bibliography on Sedimentation*. Issued as Sedimentation Bulletin No. 2 (February 1950), the publication covers all essential material in the field found in the principal New York libraries and in 150 English-language proceedings of the leading engineering societies. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at $1.25 each.

Atomic Energy. Control of radiation hazards is discussed in the Eighth Semi-annual Report of the Atomic Energy Commission to Congress, which may be obtained from the U. S. Government Printing Office, Washington, D.C., for 55 cents. The report is sold under the title, *Control of Radiation Hazards in Atomic Energy Program*.

Hydraulic Research. The annual compilation of reports by the various hydraulic and hydrologic laboratories in the United States and Canada has been issued by the Hydraulic Laboratory of the National Bureau of Standards. Copies of this bulletin, entitled *Hydraulic Research in the United States*, are available without charge from the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D.C.

Precipitation Data. Data collected at the time of the destructive flood occurring in the Crooksville (Ohio) area on June 16 and 17, 1950, have been assembled in a preliminary report of the State of Ohio Department of Natural Resources, Division of Water. Intended as an aid in the design of future protection works, the report is presented as part of the long-range cooperative investigation of the water resources of the state being conducted by the Ohio Division of Water and the Water Resources Division of the U.S. Geological Survey. Inquiries should be sent to the State of Ohio Division of Water, Columbus, Ohio.

Irrigation. Friction head losses in certain types of valves, strainers, and fittings commonly used in irrigation plants is the subject of a recent bulletin, *Friction Losses in Selected Valves and Fittings for Irrigation Pumping Plants*, by Carl Rohwer, senior irrigation engineer, U.S. Department of Agriculture. The work leading to the bulletin was conducted in cooperation with the Bellevue Hydraulic Laboratory of the Colorado Agricultural Experiment Station of Colorado A & M College. Copies are available from the Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo., at 50 cents each.

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Engineering Research. Recent structural engineering research conducted in the Engineering Experiment Station at the University of Illinois is reported in a series of bulletins now available from the Station at Urbana, Ill. These are Bulletin No. 384 on *Fatigue Strength of Various Types of Butt Welds Connecting Steel Plates*, 50 cents; Bulletin No. 385, dealing with *Moments in Two-Way Concrete Floor Slabs*, 60 cents; Bulletin No. 386, entitled *Studies of Highway Skew Slab-Bridges with Curbs*, 45 cents; Circular No. 59, covering *Input of a Slotted Cylinder Antenna*, 40 cents; and Circular No. 60, which contains a group of *Lectures on Foundation Engineering*.

Pollution Control. Recommended practices to prevent stream pollution from oil pipeline breaks are outlined in a manual released by the Ohio River Valley Sanitation Commission. The manual was compiled from information secured from 15 major oil companies and other sources. Copies are available from Edward J. Cleary, executive director and chief engineer of the Commission, 414 Walnut Street, Cincinnati, Ohio.

Cement. Hubert C. Persons, in *The Portland Cement Industry*, No. 18 in the American Industries Series of the Bellman Publishing Co., Inc., gives a detailed history of the industry, methods of production, and a section on the Portland Cement Association. Copies may be purchased from the publisher at 83 Newbury Street, Boston 16, Mass., for $1 each.

Building Codes. Copies of the new basic building code of the Building Officials Conference of America, Inc. are now available through George E. Strehan, correlator at BOF headquarters, Room 1401, 51 East 42nd Street, New York, N.Y., for $6.50. The abridged code for smaller cities may be obtained at the same address for $4.50 and $3.00 a copy.

Pollution Progress. Progress in stream pollution abatement through the extensive construction of waste-treatment plants in the state of Georgia is described in the *Georgia Water Pollution Control Comprehensive Report* for July 1950. Inquiries should be addressed to the Georgia Department of Public Health, Water Pollution Control, Atlanta, Ga.

Irrigation. A provisional report discussing consumptive use and irrigation water requirements of crops in irrigated areas of Colorado has been prepared by Region 6 of the Department of Agriculture Soil Conservation Service. Inquiries about this report should be addressed to the U.S. Soil Conservation Service, Washington 25, D.C.

E. S. L. Bibliography. An annotated bibliography of 101 selected references to the literature of the past twelve years on all aspects of nonmetallic bearings has been issued by the Engineering Societies Library under the title *The Bibliography on Non-Metallic Bearings*. It may be purchased from the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y., for $2.

Atomic Protection. A practical manual, *Atomic Attack*, by John L. Balderston, Jr. and Gordon W. Hewes, giving methods for increasing the individual's chance for survival in atomic war, has been published under the auspices of the Council on Atomic Implications, at the University of Southern California. Copies are being distributed by Culver Products Co., Culver City, Calif., for $1.

Federal Reorganization. Functions and activities of the federal government as of July 1 are given in the 1950–1951 edition of the *United States Government Organization Manual*, recently released by the General Services Administration. Copies may be purchased for $1 each from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Hydrology. Meteorological and hydrologic events of the 1945–1946 season at the Central Sierra Snow Laboratory are presented by means of text, graphs, and tables in Technical Report No. 5 of the Corps of Engineers, the Commerce Department, and the U.S. Weather Bureau, in two parts. Entitled *Hydrometeorological Log of the Central Sierra Snow Laboratory, 1945–1946*, the report may be obtained from the Division Engineer, South Pacific Division, Corps of Engineers, Oakland Army Base, Oakland 14, Calif.

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TABLE OF ASTM A305 SPECIFICATIONS

		NOMINAL DIMENSIONS ROUND SECTIONS			REQUIREMENTS OF DEFORMATIONS		
Bar No.*	Unit Wt. Lbs. Ft.	Diameter-Inches Decimal	Cross Sectional Area Sq. Inches	Perimeter	Max. Avg. Spacing In.	Min. Height Inches	Max. Gap Inches‡
2†	0.167	0.250	0.05	0.785	.. ..	.. .	.. ..
3	0.376	0.375	0.11	1.178	0.262	0.015	0.143
4	0.668	0.500	0.20	1.571	0.350	0.020	0.191
5	1.043	0.625	0.31	1.963	0.437	0.028	0.239
6	1.502	0.750	0.44	2.356	0.526	0.038	0.286
7	2.044	0.875	0.60	2.749	0.612	0.044	0.334
8	2.670	1.000	0.79	3.142	0.700	0.050	0.383
9‡	3.400	1.128	1.00	3.544	0.790	0.056	0.431
10‡	4.303	1.270	1.27	3.990	0.889	0.064	0.487
11‡	5.313	1.410	1.56	4.430	0.987	0.071	0.540

*Bar numbers are based on the number of ⅛ inches in the nominal diameter of the section.
†Bar number 2 in plain rounds only.
‡Bars numbered 9-10-11 correspond to former 1" sq., 1⅛" sq., and 1¼" sq. sizes, and are equivalent to those former standard bar sizes in weights and nominal cross-sectional areas.
‡Chord of 12 ½% of Nom. Perimeter.

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EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Adjustable Measuring Guide

IT IS NOW POSSIBLE to make angle cuts, 45 deg and 90 deg, with ease on any masonry material, with the introduction of the "Guide-A-Cut" adjustable measuring guide, adaptable to any Clipper masonry saw conveyor cart. The "Guide-A-Cut" eliminates the need for tacking material guide strips on the conveyor cart or the use of a special cart. Quickly and easily adjusted, this cast metal guide enables the masonry saw operator to quickly cut an accurate 45 deg angle or straight cut. At the same time it holds the material firmly to eliminate slipping (the cause of most blade breakage). **Clipper Manufacturing Co., Dept. C, 2800 Warwick, Kansas City, Mo.**

Compaction Roller

A MORE FLEXIBLE COMPACTION ROLLER is announced. It consists of a series of weight box units, each equipped with a wheel and tire. These units are filled with wet or dry sand, earth, steel scrap or other materials. As the roller is towed over the variable surface of the earth fills the units oscillate up and down and provide a constant and unchanging compaction weight on each tire, thus there is no bridging nor sudden shifting of combined weight on any one or two wheels. A sectionalized tubular yoke permits the use of from three to six of the weight-box units. Compaction loads range up to 15 tons per tire. The

Features Flexibility

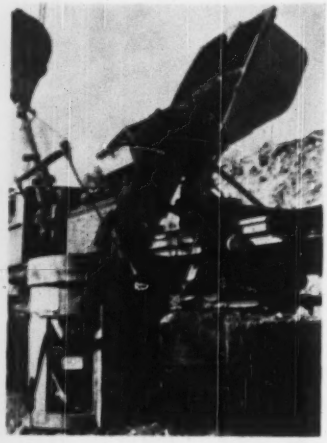
heavy, welded box-type goose-neck permits short turning in confined areas. **Southwest Welding & Mfg. Co., Alhambra, Calif.**

Square Edge Forms

A NEW TYPE ATLAS square edge form especially designed for use on all structures where architectural concrete is required, is now supplied with the improved Atlas captive fastener. The fastener, permanently attached to the form, eliminates waste motion due to extra handling and misplacing of parts. Atlas square edge forms can be crane handled in large panels or in light individual units for erection by one man. They can be used with wood or steel walers using any standard make wall ties. Basic units are 12" wide and are supplied in varying lengths of 4 ft to 8 in. **Irvington Form & Tank Corp. Dept. CV-E, 20 Vesey St., New York 7, N. Y.**

Rail Mounted Dumpcrete

A DUMPCRETE BODY with special built-on chute mounted on a railroad flatcar hauls an average of 1 yd of concrete per min, 24 hrs per day on Big Creek Dam No. 4 now under construction. A locomotive moves the flatcar from mixer to bucket and back with only 10 sec required to pour four yds of concrete from Dumpcrete into the 4 yd Gar-Bro bucket. This system does



away with the necessity of hooking and unhooking buckets at each trip of the conveyor cable, thus saving the cost of a hooker, and also saving 30-40 sec on each cycle, giving about 10 percent more production. The operator controls the Dumpcrete pouring mechanism from the cab of the locomotive. **Dumpcrete Div., Maxon Construction Co., Inc., 131 N. Ludlow St., Dayton 2, Ohio.**

Sand Pump

A MODEL "K" HEAVY DUTY centrifugal sand pump which is designed for higher efficiency and trouble-free operation features two piece frame construction which permits the rubber-lined or special-alloy intake chamber to be replaced readily. An improved patented check valve eliminates leakage. It gives longer check valve life, better bearing protection and easier removal of check valve and associated parts. Additional features include the easy removal of wear parts without disturbing the intake or discharge piping and the ready adjustment of wear parts for maximum efficiency and extended life. The sand pump is available in direct connected, belt-driven and overhead V-belt driven types in 1, $1^1/_2$, 2, $2^1/_2$, 3, 4, 5, 6 and 8 in. discharge. Rubber covered wear parts are available for all sizes and are interchangeable with the hard iron parts. **A. R. Wilfley and Sons, Inc., Denver, Colo.**

Vacuator

THE VACUATOR is a compact, high capacity unit utilizing the principle of controlled vacuum flotation to remove solids, grit and scum from sewage and industrial wastes. Operating at overflow rates of from 5,000 to 10,000 gals per sq ft per 24 hours, it makes a three product separation of grease, scum and light solids-sludge containing substantial quantities of grit and an improved effluent for subsequent treatment. Major applications are as a grit and scum removal unit, as a complete primary unit and as a sole treatment unit. Major advantages are high overflow rates with corresponding savings in construction costs, low power requirements, no odor nuisance and overall acceleration of the sewage treatment process. **The Dorr Company, Barry Place, Stamford, Conn.**

Tractors

EARLY PRODUCTION OF TWO new high-speed, long haul and high-capacity earth-moving machines is announced. The powerful two-wheel diesel prime mover, the "Cat" DW21 equipped with the No. 21 scraper, has five forward travel speeds, which range from 2.16 m.p.h. in first gear to 20.0 m.p.h. in fifth gear. Reverse speed is 2.79 m.p.h. Overall length of the tractor-scraper combination is 40 ft., 7 in.; width is 11 ft, 6 in.; height is 10 ft, 7 in.; and the wheelbase is 24 ft 7 in.

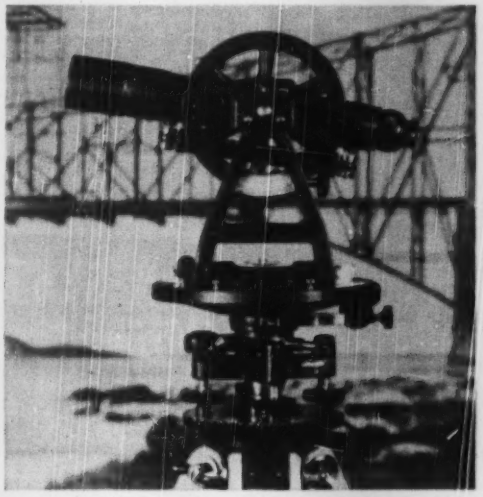
DW21 Equipped with No. 21 Scraper

The wheel tread is 84 in. Bar tread tires, interchangeable between tractor and scraper are 24.00 × 29, 24 ply. Positive hydraulic follow-up steering, 90 deg each way, is provided which permits a non-stop turn with the scraper in 35 ft. The cable controlled No. 21 scraper has a struck capacity of 15 cu yds; a heaped capacity of $19^1/_2$ cu yds; and a 9 ft, 6 in. cut. The struck capacity of the scraper may be increased to 18 cu yds and the heaped capacity (based on a 1:1 slope) increased to $22^1/_2$ cu yds by means of 12 in. sideboards. Approximate shipping weight of the combination is 47,500 lbs. The DW21 tractor is also equipped with a bucket-type seat, which is spring mounted. It is adjustable forward and backward and has a hydraulic snubber. The second new unit includes a four-wheel deisel tractor wagon combination "Cat" DW20 tractor equipped with W20 wagon. **Caterpillar Tractor Co., Peoria 8, Ill.**

Another technical editor confirms reasons why engineers prefer Gurley Aluminum Transits

Combining durability and lightness with precision for surveying transits

by David W. Veit
Editor, Die Castings Magazine



MANY surveying instruments built by W. & L. E. Gurley, Troy, N. Y., are accurate within one second of arc. If projected, this represents a maximum error of ⅜ inch in a mile.

However, precision is not the only requirement of these instruments. At least three other major factors influence the design and choice of materials for this type of equipment.

In the first place, a surveyor's transit must not only *be* accurate, but must maintain its accuracy over an indefinite period of years despite all sorts of weather and climatic conditions —heat, sub-zero temperatures, dampness, dust or salt-saturated atmospheres.

Second, it must withstand rough usage. This is outdoor equipment subjected to impact and abrasion.

The third requirement — no less important than the other two to the surveyor who carries the transit around all day long —is lightness.

The combination of accuracy and ruggedness could be secured by constructing the transit of heavy-sectioned castings, forgings or fabrications in steel or bronze, extensively machined and elaborately assembled. This choice of materials would, however, fail to include one significant feature—lightness.

The way in which Gurley has been able to combine all three desirable features has been by turning to aluminum for a major group of components. And since aluminum has been picked to fulfill the physical and mechanical needs of these surveyor's transits, it is not surprising that several of the most important parts are being produced most economically by die casting.

Die cast aluminum parts include the truss standard, telescope housing and leveling spider, as well as rod targets and tripod clamps. Aluminum alloys used for these transits have greater stability and rigidity than bronze. In addition, the die casting process permits unitary construction of the mounting frame, contributing further to rigidity.

From the point of view of weight reduction, aluminum die castings have permitted a 25 percent decrease in total weight, as compared with sand cast bronze. Die cast aluminum offers additional weight saving advantage, even as compared with sand cast aluminum, due to the thin, uniform wall section which is practical by die casting.

This pioneering instrument builder has used aluminum die castings wherever possible; this is one of the few production short cuts possible in a manufacturing operation characterized by extensive machining, finishing and assembling operations within close tolerances.

This company has maintained its leadership in the field of engineering and other types of instruments by a willingness to investigate and introduce into their production line the new materials and methods made available by technological advance. The excellent reputation of this company's instruments during the past century is sufficient testimony for the reliability of the materials which they use.

Reprints of the full-length article from which this is reproduced are available on request.

Field-proven over 74 years—Gurley Aluminum Transits are used from the Arctic to the Tropics. In the words of a combat engineer during World War II, "These instruments were subjected to the worst degree of heat, cold, mud, and dust a transit *should not* have. After being dropped, and everything else imaginable, they still did work up to par." The first Gurley Aluminum Transit was retired after 50 years of service to join the exhibit of Gurley "firsts." Gurley Instruments are described in Bulletin 50. Would you like a copy?

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Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments and Meteorological Instruments

Slide Rule

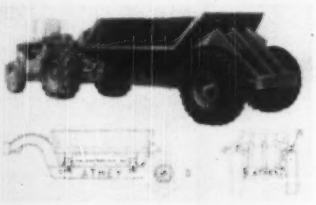
A POCKET-SIZED PLASTIC SLIDE RULE, 7 in. by 2¾ in., offers to structural engineers an accurate and time saving method of designing reinforced concrete beams and slabs. By setting the graduated slide on the known quantities, such as moment and shear, the required beam size, steel area, stirrups, unit shear, bond, K value, etc., are indicated for complete beam design. This slide rule eliminates practically all need for formulas, tables, charts or multiplying slide rule, is applicable for all values of design stresses and assures a solution without error. **Seymour Lester, 7906 Santa Monica Blvd., Hollywood 46, Calif.**

Hydraulic Pipe-Line Dredge

A PORTABLE HYDRAULIC pipe-line dredge, called the "Little Dragon," is designed for extreme portability, for shipment by truck or rail. The dredge is capable of digging up to depths of 20 ft below the surface of the water and has a rated output of 50 to 150 cu yds per hour, depending upon operating conditions. The "Little Dragon" meets the requirements of a small, efficient dredge for general construction work, deepening reservoirs, stream pollution control, and real estate improvement and can be used at power plants, chemical plants, yacht clubs and marine terminals. **Ellicott Machine Corp., 1611 Bush St., Baltimore, Md.**

PD Series Trailer

A HIGH-SPEED TRAILER, the PD-20 has just been announced. It is matched and designed for use with the recently announced Caterpillar DW20 diesel tractor. Design of the PD-20 closely resembles the PD-10 series with several innovations which provide even more stability both in traveling and discharging the load. The unit is constructed of high strength steel with emphasis on impact resistance and is of all-welded construction throughout.



Model PD-20

The design is a semi-bathtub type with modified tapered sides and one low side for easier loading and dumping. The unit can be equipped to dump either to the right or to the left. The body is dumped by hydraulic power supplied from the tractor. The overall length of the tractor and trailer is 42 ft ⅝ in. The width 12 ft 2½ in. and the height 9 ft 6 in. The trailer has a wheel base of 24 ft and a tread of 102 in. The clearance under the frame of 24⅞ in. is sufficient to clear unusual road obstacles. The bottom of the wagon is constructed of double plate steel with oak fillers which is designed to absorb the shock of heavy shovel loading. Shock absorbers are rubber body pads similar to those used on PD-10Q. **Athey Products Corp., 5631 West 65th St., Chicago 38, Ill.**

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MICRO SURVEYING ALTIMETER

MODEL M-1 . . . Range 6,000 feet (—1000' to + 5000') in intervals of 1'

MODEL M-2 . . . Range 10,000 feet (0' to 10,000') in intervals of 2'

MODEL M-5 . . . Range 15,000 feet (0' to 15,000') in intervals of 5'

MODEL MM-1 . . . Range 5,000 meters (0 to 5,000 meters) in intervals of 1 meter

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MODEL SA-1 . . . Range 4,360 feet (—760' to + 3,600') in intervals of 2'

MODEL SA-2 . . . Range 10,600 feet (—900' to + 9,700') in intervals of 5'

MODEL SA-3 . . . Range 15,000 feet (—500' to + 14,500') in intervals of 10'

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Literature and Technical Publications Available on Request

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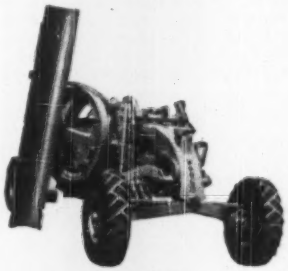
A CEMENT-MORTAR LINING SERVICE for old, small diameter pipe lines, that gives new pipe line performance at a fraction of new pipe line costs, is announced. The work can be carried out on pipe lines in place, without discontinuing regular service. Through the use of highly specialized, patented equipment, the process first cleans corroded matter and tubercles from inside pipe walls, and then applies a smooth cement-mortar lining to the walls. As a result, leaks are eliminated, flow coefficients are restored and pumping costs are reduced. All the advantages of concrete and steel pipe construction are obtained, including elimination of water discoloration, elimination of further cleaning for all time, and protection against bacteria. Equipment used is portable by special trucks so that all types of locations can be handled. Complete information is available from **Pipe Linings, Inc., P.O. Box 3428 Terminal Annex, Los Angeles, Calif.**

Equipment, Materials & Methods (Continued)

Motor Grader

THE 4D-SERIES MOTOR GRADER, pictured here, is built especially for high bank cutting, which calls for one of the more difficult blade positions. Formerly, this involved time-consuming manual adjustment of linkages to attain such an extreme position. The manufacturers of the Warco



Series 4-D

line have eliminated this operation. The operator can elevate and angle the blade entirely by manipulation of the cab controls, saving valuable time on the job. **W. A. Riddell Corp., Bucyrus, Ohio.**

Fire Hydrant

BALL BEARING OPERATION is one of several unusual and significant features incorporated in a fire hydrant recently developed. The new type fire hydrant, known as Darling fire hydrant B-50-B, achieves three primary design objectives: (1) to greatly reduce the force needed for hydrant operation (2) to eliminate all need for a stuffing box and packing gland (3) to greatly lessen the maintenance and service requirements today accepted as normal. In addition to the ball bearing feature, the design incorporates three "O" rings, the lower one sealing against a bronze sleeve on the hydrant rod, and the two upper ones against the operating nut where it passes through both the bearing cover plate and fire hydrant bonnet. This arrangement eliminates the need for a stuffing box, dispensing with the usual maintenance and lubrication of packing and the frequent packing gland adjustment otherwise required. The arrangement likewise results in a dry head hydrant, prevents loss of the lubricant distributed to threads and ball bearings through the operating nut, and precludes the possibility of water reaching the operating threads. Bulletin No. 5007, contains descriptive information. **Darling Valve & Mfg. Co., Williamsport, Pa.**

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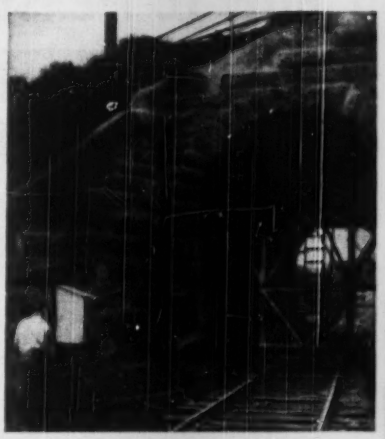
Pictured here is a type of vital repairing in which we are specialists. It has proven to be a most effective method for filling voids behind tunnel linings and solidifying bridge abutments, piers and arches.



This grade separation between the NYO & W and DL & W railroads was so greatly weakened by heavy traffic that ballast from the upper track sifted through the joints in the masonry. After pointing all joints with "GUNITE," a system of holes was drilled through the masonry. Through these we pumped sand-cement grout, completely filling all voids and joints. This built up the structure to greater than original strength.

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The new edition of this authoritative technical description of underpinning methods and applications for foundation construction has been extensively revised and brought completely up-to-date. The authors describe in detail actual cases of every type of underpinning.

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This new edition contains 201 photographs, and drawings, a glossary of terms and a bibliography. **Price $10.00**

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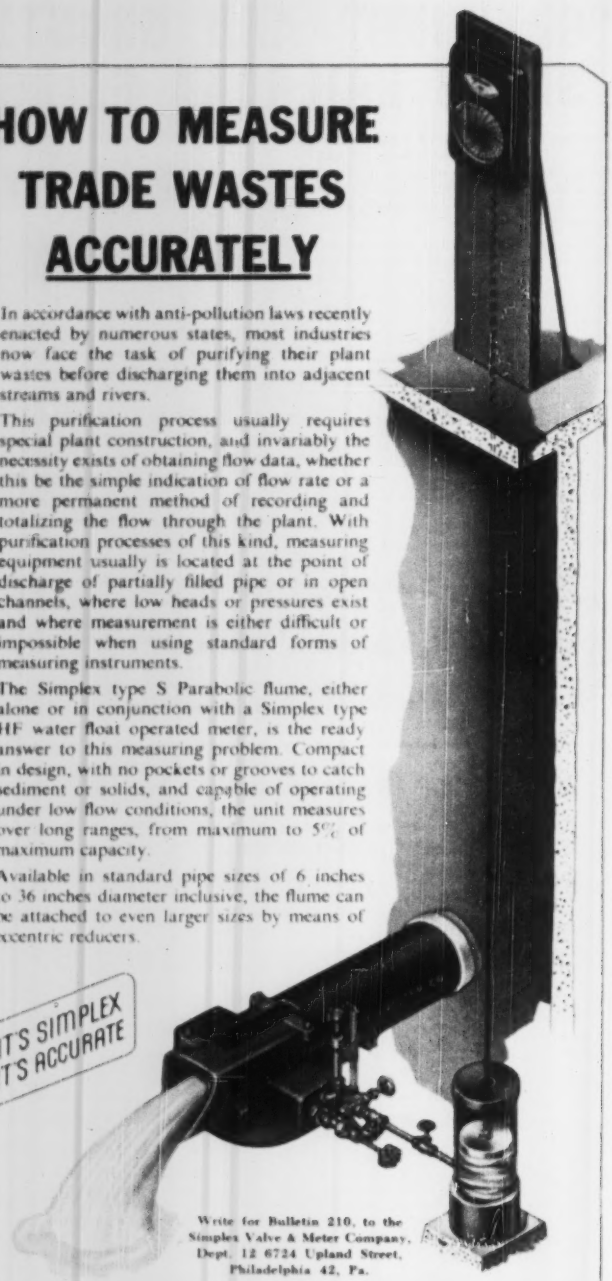
In accordance with anti-pollution laws recently enacted by numerous states, most industries now face the task of purifying their plant wastes before discharging them into adjacent streams and rivers.

This purification process usually requires special plant construction, and invariably the necessity exists of obtaining flow data, whether this be the simple indication of flow rate or a more permanent method of recording and totalizing the flow through the plant. With purification processes of this kind, measuring equipment usually is located at the point of discharge of partially filled pipe or in open channels, where low heads or pressures exist and where measurement is either difficult or impossible when using standard forms of measuring instruments.

The Simplex type S Parabolic flume, either alone or in conjunction with a Simplex type HF water float operated meter, is the ready answer to this measuring problem. Compact in design, with no pockets or grooves to catch sediment or solids, and capable of operating under low flow conditions, the unit measures over long ranges, from maximum to 5% of maximum capacity.

Available in standard pipe sizes of 6 inches to 36 inches diameter inclusive, the flume can be attached to even larger sizes by means of eccentric reducers.



Write for Bulletin 210, to the Simplex Valve & Meter Company, Dept. 12 6724 Upland Street, Philadelphia 42, Pa.

SIMPLEX

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Equipment, Materials & Methods (Continued)

Portable Air Compressor

AN IMPROVED 105 FT. PORTABLE AIR COMPRESSOR has been announced. It is lighter, lower and more maneuverable. It is built around the standard Worthington Blue Brute compressor and is powered by either diesel or gasoline engine. New features and advantages include: a new zero pressure retractable third wheel; new underslung spring-mounted undercarriage with heavy duty commercial 15 in. trailer tires; a simple, retractable support leg; a new style unit core radiator with pressure

The Blue Brute

cap to prevent boiling and better operation of engine at higher temperatures and altitudes; a new carburetor with fixed jets for better economy; and relocation of instrument panel and battery box to give unrestricted full length tool boxes. The redesigned 105 ft Worthington Blue Brute compressor is 10 in. shorter, 4 in. lower and weighs 300 lbs less than previous models. For further information write **Construction Equipment Div., Worthington Pump and Machinery Corp., Holyoke, Mass.**

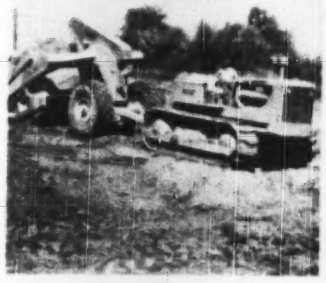
Torque Converter Equipped Tractor

A TORQUE CONVERTER equipped tractor, the HD-20, has just been introduced. 41,800 lbs of properly balanced weight, long, wide sure gripping tracks, and a new 2-cycle GM 6-110 diesel facilitate handling the toughest jobs in stride. The 660 cu in. engine gives the HD-20 plenty of power to provide longer life, less maintenance and increased production. Maximum horsepower can be utilized regularly and maintenance held to a minimum. A three stage hydraulic torque converter eliminates most gear shifting and keeps the tractor working smoothly at higher average speeds. Operating adjustments, maintenance points and major assemblies are so located and designed that the care, maintenance and repair of the tractor can be accomplished with the least possible effort and loss of time. Simple unit construction allows removal or replacement of major assemblies without disturbing adjacent parts. Positive-seal, grease packed truck wheels, idlers and support rollers are serviced at the factory and thereafter require greasing attention only once every

(*Continued on page 89*)

Equipment, Materials & Methods (Continued)

1000 hours. Top operator efficiency has been built right into the HD-20. A wide, comfortable, easily adjusted operator's seat affords maximum visibility to front and rear. Hydraulically powered steering levers that offer finger-tip steering control reduce the physical labor of driving the tractor. Adjustable brake pedals, self-energizing brakes, convenient arrangements of other controls, and a large clear operator platform are additional features. Other important points are: a larger idler and sprocket and extra long track (106 5/8 in.) on the ground provides better stability, flotation and traction. A welded A-frame tract stabilizer reduces twisting strains and offers rigid track



Model HD-20

alignment. A double reduction final drive gives greater ground clearance, permits the use of smaller gears and shorter shafts. A strong, sturdy floating equalizer spring cushions the main frame and engine from ground shocks, and helps absorb the stresses imposed by heavy duty front mounted equipment. All steel construction and extensive welding gives the HD-20 the rugged dependable make-up essential to capacity work. A torque converter automatically adjusts to the right speed at which engine horsepower and torque are high. The GM 2-cycle 6-110 diesel that delivers maximum power with a minimum of effort plus a host of other modern design features are all wrapped up in the HD-20. **Allis Chalmers Manufacturing Co., Tractor Division, Milwaukee 1, Wis.**

Sno-Flyr Rotary Plow

THE SNO-FLYR ROTARY PLOW is now adaptable to the Caterpillar motor grader to give fast, economical snow removal, plus additional auxiliary engine power for countless other jobs. When snow plowing is over, the auxiliary engines used to operate the plow are available for many jobs such as motor grader replacements, power for generators, air compressor units, hoists and derricks, rock crushers, etc. The modern design Sno-Flyr rotary with its new features including close-to-ground cleaning, snow streams individually con-

(*Continued on page 90*)

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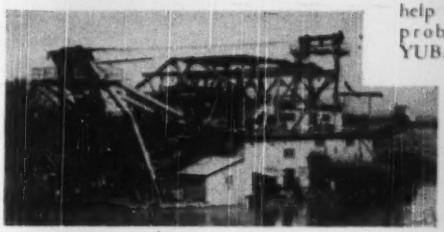
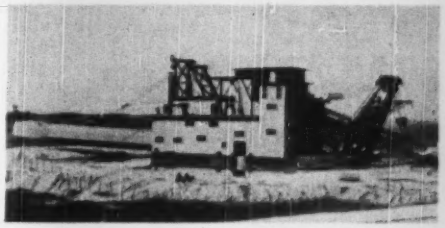
For over 40 years . . . a life-time of experience . . . YUBA has built dredges for the recovery of gold, tin, platinum, precious stones, and aggregate handling. Draw on this great fund of experience for help with your dredge problems — consult YUBA NOW.



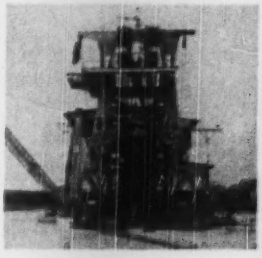
California — YUBA Dredge No. 98, with wood hull, 9 cu. ft. buckets, 50' digging depth, recovering gold for La Grange Gold Dredging Co.



Korea — YUBA Dredge No. 79, steel hull, 10 cu. ft. buckets, 33' digging depth, gold mining.

Yukon — Digging gold near Dawson for Yukon Consolidated Gold Corp. YUBA dredge with wood hull; designed for Arctic conditions. 7 cu. ft. buckets, 25' digging depth.

Montana — Perry & Schroeder Mining Co.'s dredge, built with pontoon-type hull, 6 cu. ft. buckets, and 38' digging depth for mining gold, garnets and sapphires; now being used for backfilling cofferdams at Canyon Ferry Dam site and for excavating aggregate.



Malaya — Kampar Malaya No. 1, with steel hull and 10 cu. ft. buckets, digging tin at depths to 75 ft. below water.

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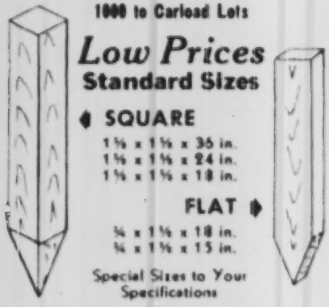

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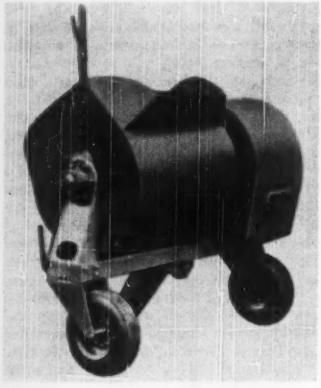
Equipment, Materials & Methods (Continued)

trolled from the cab, full 360 deg revolving chutes allowing complete casting control in any direction, wider plowing width, and many others, is easily mounted on the series 9K-2911 to 9K-9999, or 7T1 and up, or 8T1 and up, Caterpillar motor grader. The combination makes a completely cab-controlled snow plowing operation, giving positive maneuverability of plow and grader without effort. It is not necessary to have a factory mounting. The Sno-Flyt can be delivered in "package form," ready for mounting on your grader. Hitch assemblies, engine mounting frames, drive assemblies and controls are included in the package. Engines are supplied by the Caterpillar dealers. When gasoline engines are desired, two industrial type Ford engines can be included. **Wm. Bros. Boiler and Mfg. Co., Minneapolis, Minn.**

Tilting Plaster-Mortar Mixer

A TILTING PLASTER-MORTAR MIXER of 6 cu ft capacity has been added to a complete line of concrete, bituminous and plaster-mortar mixers. Featured on the mixer unit is a semi-power tilt arrangement that practically nullifies any effort required to tilt the drum. Through the action produced by the paddle shaft drive, the loaded drum tends to tilt itself when released for discharge. The drum also tilts in the opposite direction for quick, easy cleaning. Equipped with a single cylinder, air-cooled gasoline engine, power



in the mixer is transmitted by multiple "V" belt with enclosed reduction gears running in oil. Electric power is optional. Four non-clogging mixing blades, positioned at 90 deg around shaft for uniform action, are slotted for radial and longitudinal adjustment. Blades scour the drum on each revolution for end-to-end mixing and rapid discharge. A 60-in. wide steel gauge permits fast towing, and the handy 32-in. length allows this tilter to clear standard door openings. Tipping is prevented by the push-down tow-pole arrangement. Additional information may be obtained by contacting **Kwik-Mix Co., Port Washington, Wis.**

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Literature Available

LUBRICATING SYSTEMS—A catalog of interest to contractors has just been issued. It features the latest in heavy-duty lubricating systems for construction equipment. Diagrams and specification charts supplement other informative matter. **Lincoln Engineering Co., St. Louis 20, Mo.**

STEEL CYLINDER PIPE—A folder entitled "Tapping Prestressed Concrete Steel Cylinder Pipe Under Pressure," is offered. It shows step by step how to make permanent watertight connections for small and large diameter pipes. The folder is amply illustrated with pictures and diagrams. **Price Brothers Co., 1932 East Monument Ave., P.O. Box 825, Dayton 1, Ohio.**

PILES AND CAISSONS—An 8-page bulletin entitled "Concrete Piles and Caissons" has just been issued. The feature of this bulletin is a suggested standard specification for cast-in-place concrete piles. The "performance type" specification is prepared to include all recognized cast-in-place concrete piles. Described and illustrated are button bottom piles, pedestal piles, composite piles, and compressed concrete piles. The standard specifications sheet is available separately. The above bulletin may be obtained by writing directly to **Western Foundation Corp., 2 Park Ave., New York 16, N.Y.**

WIRE ROPE—An informative folder entitled, "Why you should use the *best* Winch Line," has just been released. Construction companies, public utilities, oil field truckers, in fact anyone who buys or specifies wire rope for winch machinery, will find this 4-page, 8½ in. by 11 in. bulletin exceedingly helpful. It points out the definite advantages of American Cable Winch line which result in greater man and machine efficiency, more work handled, longer rope life and extra safety. For your copy of this folder, write to the **American Cable Division, American Chain & Cable Co., Inc., Wilkes-Barre, Pa.**

MATERIAL HANDLING—A 16-page booklet shows how proper "positioning" of materials saves unnecessary handlings during production operations. It contains illustrations and descriptions of 12 different types of equipment of various manufacturers. These point out many proved ways of "positioning" materials. Two illustrative Process Charts are given as examples for determining the extent of handling operations from time of receipt of materials to the shipment of the finished product. These charts also show that "positioning" operations exceed those of transportation and tiering combined and consequently should receive more attention than they do in most industries. Copies of this booklet "Material Handling—At the Machine" may be obtained direct from **Lyon-Raymond Corp., 12962 Madison St., Greene, N.Y.**

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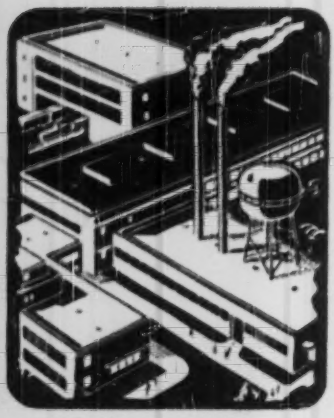
Above: Section of typical echo depth recording showing depth and bottom contour. Clearly reveals composition: Mud, rock, etc. Precision recorder prices begin at $3300.



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Literature Available (Continued)

POWER PLANTS—A circular describes the Katolight AC power plants designed for farms, homes, industry, and institutions. It gives specifications, standard equipment, and accessories. Charts are also included with other general information. **Kato Engineering Co., 1415 First Ave., Mankato, Minn.**

POROUS MEDIA—A 56-page engineering bulletin on porous media is offered. It is a complete reference covering all filtration and diffusion applications for ceramically bonded media. Numerous charts, tables and illustrations supplement the technical information that deals with uses, design, installation, operation, and specifications. **Carborundum Co., Refractories Div., Perth Amboy, N. J.**

EXPANSION JOINTS—A 16-page Bulletin, No. R-35-51, explains design and construction of Corruflex, ADSCO's corrugated packless expansion joint that requires no maintenance. Complete description of line includes sizes, temperature and pressure ratings, dimensions and weights. Simplified selection charts make it easy to determine proper joint for most applications. Illustrated with photos of types, cutaway view and typical installations. **American District Steam Co., North Tonawanda, N.Y.**

METALLIZING SYSTEMS—Bulletin 93 briefly describes the Metco Systems and their uses and applications. This new technique prevents rust on tanks, bridges, piling, ship and boat hulls, refrigeration equipment and fabricated steel products for 25-50 or 100 years. The systems provide pure zinc or aluminum coatings properly treated to withstand various corrosive conditions. Send for your copy of "Corrosion Prevention with the Metco Metallizing Systems" today. **Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y.**

TRACTOR SERVICE MANUAL—A 220 page service manual featuring Allis-Chalmers HD-5 crawler has just been released. This service book is separated into 23 sections. The portions, 1 through 19 feature a general description of the tractor, complete specifications and a detailed pictorial and written description of the various assemblies of the machine as well as instructions for the proper adjustments and repairs when rebuilding these assemblies. Where special tools are required, in making repairs, their application and use are illustrated in section 20. Sections 21 and 22 are devoted to general maintenance instructions. Section 23 contains trouble shooting information and indicates tests which can be made to help determine more easily the cause of mechanical difficulties which may arise. Copies of this manual can be obtained for $3.00 each. **Tractor Div., Service Dept., Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wis.**

AUTOMATIC
Sewage Regulators

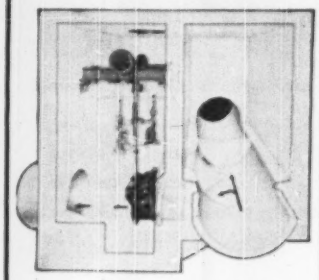

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request

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Literature Available (Continued)

HOIST TOWERS—Late developments in hoist tower design and construction are revealed in a 6-page bulletin, "Gold Medal Hoist Towers," just issued. Use of tubular steel components contribute to safety, efficiency, economy, appearance and low-cost service. Dimensions, specifications and diagrams for both light and heavy towers are included. Sketches and photographs illustrate actual applications. Bulletin HT-2 is available from **The Patent Scaffolding Co., Inc., 38-21 12th St., Long Island City 1, N. Y.**

THE HEILINER—An exhaustive brochure on the 2C800 Heiliner, in full color, has eight 11 in. by 16 in. pages and a cover from an original kodachrome. Featured are job pictures, cutaways, and specifications of the Heiliner with its interchangeable scraper and bottom dump wagon. Highlighting the presentation is information on the Heil patented Hydro-Steer and Super-Axle, and on the Cummins 200 hp diesel engine which powers the unit. Forty refinements of the Heiliner are also illustrated. **The Heil Co., Milwaukee 1, Wis.**

SINGLE DRUM HOIST—A 16-page bulletin, 76-X, just released, describes the complete line of Joy single-drum, multi-purpose hoists for mines, construction jobs, oil fields, and industrial plants. The bulletin contains complete descriptions and specifications for hoists with capacities from 500 to 3500 lbs and driven by turbinair, pistonair, electric, or gasoline engines. A handy Select-O-Hoist chart simplifies the choice of any hoist to fill a particular need. **Joy Manufacturing Co., Oliver Bldg., Pittsburgh 22, Pa.**

TRUSSED RAFTERS—A brochure entitled "Wood Frame Teco Trussed Rafters" will be of interest and immediate value to architects, engineers, contractors, and those responsible for military construction. Originally designed for residential buildings, the clear-span trussed rafters are equally adaptable to small industrial and commercial buildings, churches, schools, apartments, factory buildings, etc. This whole concept is set forth in text, pictures and diagrams, together with detailed descriptions of latest approved methods of applying the Teco wedge-fitted split-ring connectors and Trip-L-Grip framing anchors. **Timber Engineering Co., 1319 Eighteenth St., N.W., Washington 6, D.C.**

MOTOR-GENERATOR—An eight-page, two-color booklet on synchronous motor-generator sets has been announced. Designated as GEA-5500, the publication covers motor-generator sets from 30 to 8000 kw as a source of D-C power for many industrial applications, such as rolling-mill motors and other drives, electrolytic refining of ores, excitation for synchronous and D-C motors and generators, motion picture lighting, mining and quarrying, wind tunnels and other large testing equipments, and general purpose use. Well illustrated, the booklet shows four typical installations and describes the construction features of the synchronous motors and D-C generators. **General Electric Co., Schenectady 5, N. Y.**

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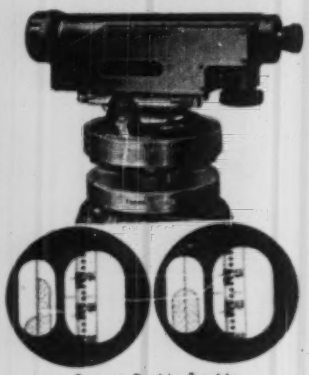

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WELDING AND CUTTING—"The Oxy-Acetylene Flame Master of Metals" is the title of a new 20-min motion picture on oxy-acetylene welding and cutting. Produced in sound and color, it is the co-operative effort of the International Acetylene Association and the United States Bureau of Mines. The film explains what the oxy-acetylene welding and cutting processes are and what they will do. It takes the audience right into the foundry and into the fabricating plant and shows how the oxy-acetylene processes are used to cut risers on castings, produce welded aluminum chair frames, and prepare H- and I-beams for heavy steel construction. Animated sequences show how calcium carbide and acetylene are produced, and why oxygen and acetylene are so effective in producing the "hottest flame on earth." The workings of welding torches, cutting torches, and oxygen and acetylene regulators are clearly explained. This motion picture should have particular appeal to vocational schools, agricultural and engineering colleges, and high school science and vocational classes, as well as to business groups. Requests to borrow copies of the film should be addressed to the **Supervising Engineer, Graphic Services Section, Bureau of Mines Experiment Station, 4800 Forbes St., Pittsburgh 13, Pa.**

PIPE LINE CONSTRUCTION—All phases of pipe line construction—including trenching, rock drilling, blasting, welding, doping, wrapping, laying and backfilling—are pictured in a new construction film titled, "As the Crow Flies." All scenes were photographed in the Cumberland Mountains, between Green Brier and Oak Ridge, Tennessee. Action shows construction work on the 172-mile, 22 in. natural gas line laid by Oman-Fulton-Brodie Company of Nashville, Tennessee, Lubbock, Texas, and Amarillo, Texas, for the East Tennessee Natural Gas Co. A large part of the 172-mile line runs through rock, and the movie includes a demonstration of the new rock drilling technique used successfully on this job. The approximate running time is 21 min for 750 ft of 16-mm film, black and white, with sound track. Bookings for interested groups may be arranged by contacting **Gardner-Denver Co., Quincy, Ill.**

VITRIFIED CLAY PIPE—The story of a timeless industry is brought to life in full color in a new sound movie entitled "Out of the Earth." Filmed at The Robinson Clay Product Company's largest and most modern plant at Pottstown, Pa., the picture tells of the progressive manufacturing techniques now applied to the production of vitrified clay pipe. This film is available to engineers, plumbers, contractors and building suppliers throughout Robinson's 18-state eastern and north central marketing territory. To insure availability, requests should be mailed in advance of requirements. Simply write to: **The Robinson Clay Product Co., 65 W. State St., Akron 9, Ohio.**

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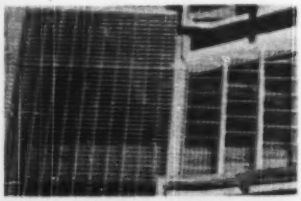

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Closed to Further Discussion

16. Pavement Bearing Capacity Computed by Theory of Layered Systems by Guthlac Wilson, M. ASCE, and G. M. J. Williams, Jun. M. ASCE.

17. Origin and Significance of Openwork Gravel by Allen S. Cary, Assoc. M. ASCE.

18. Successive Approximations for Beams on an Elastic Foundation by E. P. Popov, Assoc. M. ASCE.

19. Flood-Control Operation of Tennessee Valley Authority Reservoirs by Edward J. Rutter, M. ASCE.

20. Three-Dimensional Displacement Diagrams for Space Frame Structures by Walter Worthington Ewell, Jun. M. ASCE.

21. Maximum Load Capacity of Bailey Bridges by Robert B. Stegmaier, Jr., Jun. M. ASCE.

22. Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy, Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys.

23. Influence of Heavy Loads on Pavement Design Trends by K. B. Woods, M. ASCE.

24. Summary of Buckling of Rigid-Jointed Plane Trusses by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

25. Uplift Pressures in Concrete Dams by Kenneth B. Keener, M. ASCE.

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei.

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh.

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich.

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld.

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman.

26. Industrial Stream Pollution Abatement, by L. L. Hedgepeth.

27. Plasticity of Metals—Mathematical Theory and Structural Applications, by D. C. Drucker, Assoc. M. ASCE.

28. Retrogression on the Colorado River Since 1935, by J. W. Stanley.

29. Sedimentation Studies at Conchas Reservoir in New Mexico, by D. C. Bondurant, Assoc. M. ASCE.

30. Economic Effects of Reservoir Sedimentation, by W. E. Corfitzen, M. ASCE.

Summarized in Earlier Issues

31. Measurement and Analysis of Suspended Sediment Loads in Streams, by Martin E. Nelson and Paul C. Benedict.

32. Effect of Skew Angle on Rigid-Frame Reactions, by Walter C. Boyer.

33. Strength of I-Beams in Combined Bending and Torsion, by Basil Sourochnikoff.

34. Lateral Buckling of Eccentrically Loaded I-Section Columns, by H. N. Hill and J. W. Clark.

35. Design Curves for Footings on Soil, by Winfield A. McCracken.

D-XXII. Discussion of Paper, **Analytical Method of Determining the Length of Transition Spiral,** by Michael V. Smirnoff.

D-XXIV. Discussion of Paper, **Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development,** by D. J. Bleifuss.

36. Impossibility of Performance in Contracts for Engineering and Construction, by Robert F. Borg.

37. Design of Prestressed Tanks, by J. M. Crom.

38. Hydrology of Mexico, by Andrés García-Quintero.

39. Practical Design of Solid-Barrel, Reinforced-Concrete Skew Structures, by Bernard L. Weiner.

40. Technique of Passing Floods Over Earth Dams During Construction, by Andrew Weiss.

D-XXVI. Discussion of Paper, **A Study of End Connections for Struts,** by Marshall Holt and J. W. Clark.

41. Ship Response to Range Action in Harbor Basins, by Basil Wrigley Wilson.

42. Wind-Load Standards in Europe, by John W. T. Van Erp.

Third Notice

43. Settlement Correction at La Guardia Field, by John M. Kyle. After its establishment as an airport for the City of New York, N.Y., a part of La Guardia Field was observed to settle. On several occasions prior to August 1946, unusual storms and high tides drove sea water over this area, making it unfit for use during considerable periods. The paper describes the sequence of construction operations required to correct the situation. (Available December 1.)

44. The Problem of Wave Action on Earth Slopes, by Martin A. Mason. Wave action on earth slopes and the possible application of wartime developments to the knowledge of wave action, particularly in regard to methods for the prediction of wave action, is discussed in this paper. The Sverdrup-Munk method of predicting wave height and period from synoptic weather maps is recommended as a substitute for the older purely empirical methods. The Iribarren formula for the calculation of sizes of stone required on various slopes for protection against wave action is suggested as the only available satisfactory method of design. (Available December 1.)

45. Comprehensive Plan for the Columbia Basin, by William Whipple. Cooperative planning of several government agencies has resulted in congressional authorization of an unprecedentedly large system of multiple-purpose reservoirs and related works for the Columbia Basin. The Grand Coulee, Bonneville, and McNary projects are only initial units of this system, which will ultimately have a 10,000,000-kw output. The planning involved a variety of different problems including preservation of migrating salmon, priorities of water use for irrigation, and reliable flood control in a multiple-purpose system. (Available December 1.)

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5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

Standing orders for all Separate papers, including discussions, may be entered at the following annual rates: Members of ASCE, $3.00; members of Student Chapters, $5.00; non-members, $10; libraries, $5.

TRANSACTIONS. All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

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D-4. Discussion of Paper, **Capillary Phenomena in Cohesionless Soils,** by T. William Lambe. The original paper, published in February 1950, explained the fundamentals of capillarity in cohesionless soils. Discussers are: M. R. Lewis, Peng Swe-tse, D. P. Krynine, and T. William Lambe. (Available December 1.)

D-5. Discussion of Paper, **Elastic Restraint Equations for Semi-Rigid Connections,** by J. E. Lothers. The original paper, published in February 1950, discussed the restraining effects of semirigid, girder-column connections. Discussers are: Lloyd T. Cheney, Thomas C. Kavanagh, Dean F. Peterson, Jr., and Jack E. Cermak, and J. E. Lothers. (Available December 1.)

D-10. Discussion of Paper, **Pollution Abatement Policy,** by Thomas R. Camp. The original paper, published in March 1950, outlined a policy to guide engineers and others interested in pollution abatement. Discussers are: J. E. McKee, Elwood L. Bean, and Thomas R. Camp. (Available December 1.)

Second Notice

D-XXIII. Discussion of Symposium, **High-Velocity Flow in Open Channels.** The original symposium, published in November 1949 PROCEEDINGS (p. 1287), treated the broad applicability of elastic wave analysis of problems of high-velocity flow arising from changes in open-channel cross section. Discussers are: Paul Baumann; N. N. Bhandari; T. Blench; Clarence A. Hart; Fred W. Blaisdell, J. H. Douma; Arthur T. Ippen; Robert T. Knapp; and Hunter Rouse, B. V. Bhoota, and En-Yun Hsu. (Available December 1.)

D-XXVIII. Discussion of Paper, **Movements in the Desiccated Alkaline Soils of Burma,** by F. L. D. Wooltorton. The original paper, published in January 1950 PROCEEDINGS (p. 63), described vertical movements in the tropical soils of the Mandalay District. Discussers are: Lars F. Winterkorn, J. E. Jennings, and F. L. D. Wooltorton. (Available December 1.)

First Notice

46. Human Aspects of Mexican Irrigation, by Antonio L. Rodriquez. "Although Mexico's arable land per inhabitant is about equivalent to areas in the United States already adequately supplied with water, its watered land is only a third as great or only one acre per person. Far-reaching plans promise improvement, largely by irrigation. From the welfare standpoint the aim is to spread development by relatively small farms, owner operated, with federally financed water supply repayable on a rational continuous basis. The purposes and encouraging results of these efforts over two decades make interesting reading. (Available January 1.)

47. Operation and Maintenance of Irrigation Systems, by Raymond A. Hill. A description of the problems of operation and maintenance of irrigation systems, particularly in the United States, is given in this paper. Operating procedures based on deliveries of water in accordance with natural flow rights, on demand, in rotation, and on advance orders are discussed. Causes of operating waste are described and the need for measurement of water is emphasized. It is pointed out that efficient operation of irrigation projects depends on the maintenance of all storage, diversion, distribution, and drainage works in good condition at all times. Various maintenance problems are described, and attention is called to the need for more efficient equipment. (Available January 1.)

48. Compaction of Cohesive Soils: Progress Report of the Subcommittee on Consolidation of Materials in Earth Dams and Their Foundations of the Committee on Earth Dams of the Soil Mechanics and Foundations Division. In this report the subcommittee reviews the present status of the compaction of cohesive soils in earth embankments with regard to laboratory practice, the compaction of fills, the compaction requirements as related to design, and the performance of completed fills. In doing so it is pointed out that laboratory testing in its present state does not necessarily set the compaction requirements for a fill, nor is there precise correlation between laboratory compaction and the compaction achieved in the fill. (Available January 1.)

49. Large Hyperbolic Functions Computed by Fission, by F. T. Llewellyn. Hyperbolic sines and cosines are often required in the solution of cubic and quartic equations encountered in structural analysis. The primary object of the paper is to simplify this work for adaptation by practical designers and computers. The method is more precise than that of interpolation by proportional parts, and adequate precision is attained much more readily than by academic methods. Examples for solution by slide rule are included. (Available January 1.)

50. Supersonic Sounding Instruments and Methods, by Joseph M. Caldwell. The historical development of echo sounders is described, together with the comparative advantages of portable versus fixed, sonic versus supersonic, and recording versus indicating types of echo sounders. The action and reliability of echo sounders over various types of bottoms and with surface wave action are discussed from factual test results obtained under normal operating conditions. Numerical comparisons of simultaneous soundings taken with lead-line and echo sounder are presented for both firm bottom and soft bottom conditions. (Available January 1.)

D-27. Discussion of Symposium, **Design Characteristics of Lock Systems in the United States: A Symposium.** The original symposium, published in January 1950, presented the latest thought regarding the design of locks and other navigation structures. Discussers are: Basil Standing, and Frederick Griffin. (Available January 1.)

D-2. Discussion of Paper, **Public Utility Condemnation Cases in the State of Washington,** by Henry L. Gray. The original paper, published in February 1950, described the problems entailed in the condemnation cases in the State of Washington. The author argued for the improvement of engineering techniques in this field. Discussers are: H. D. Southerland, Jr., and Henry L. Gray. (Available January 1.)

D-3. Discussion of Paper, **Treatment of Foundations for Large Dams by Grouting Methods,** by A. W. Simonds, Fred H. Lippold and R. E. Keim. The original paper, published in February 1950, discussed the experiences gained in grouting the foundations of twenty or more large dams. The material is presented under three main headings—foundation grouting equipment, grouting materials, and foundation grouting procedures. Discussers are: A. Mayer; V. L. Minear; Byram Steele; James B. Hays; and A. W. Simonds, Fred H. Lippold, and R. E. Keim. (Available January 1.)

D-9. Discussion of Paper, **Atchafalaya Diversion and Its Effect on the Mississippi River,** by Leo M. Odom. The original paper, published in March 1950, explained the diversion of flood waters from the Mississippi River via the Old and the Atchafalaya rivers in Louisiana as an important factor in the control of the Mississippi River floods below the point of diversion. Discussers are: E. F. Salisbury, James F. Halsey, Jere W. Higgs, and Leo M. Odom. (Available January 1.)

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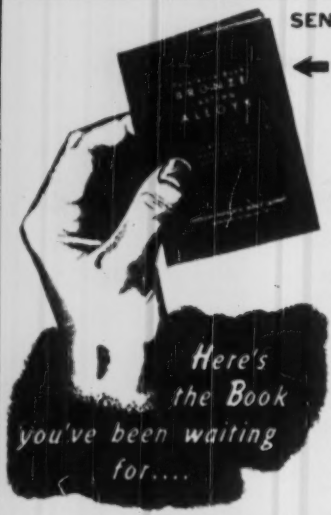

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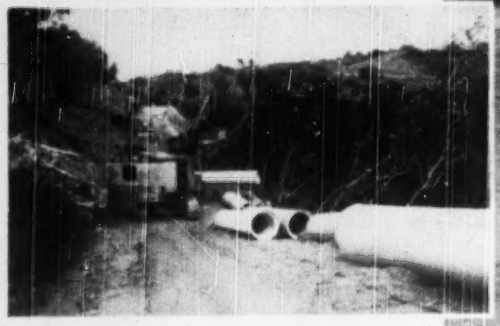

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